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A SIMPLE AND PRACTICAL TECHNIC FOR MAKING FACIAL CASTS

By ARTHUR H. BULBULIAN, M.S., D.D.S., Rochester, Minn.

THE use of facial casts in medicine and allied sciences is not new. Gottheil,[1] in 1893, advocated the use of plastic models and gave a detailed description of the method that he employed in the preparation of models representing lesions of the skin and other pathologic conditions. For his molds, he used plaster of Paris; and for his casts, he employed a mixture of beeswax and paraffin to which he added sufficient powdered cornstarch and talcum. The purpose of the cornstarch and talcum was to decrease the transparency of the mixture and give it a translucent quality. Similar mixtures have no doubt been used before by others, but, as far as I am able to find, this is the first description in medical and dental literature of such material. Many modifications of this basic formula can be made and have been made to suit the requirements of the work. Gottheil also gave sound advice concerning methods of coloring the finished cast.

Shamberg and Wallis,[2] in 1901, exhibited a set of models representing diseases of the skin. These models were made according to the method described by Gottheil. They also wrote an article about the method used in making these models and gave full credit to Gottheil for the technic that they employed.

During the last fifteen or twenty years, a revived interest has been noted in this country in the use of this three-dimensional reproduction of facial features by the oral and the plastic surgeon, the prosthetist and the orthodontist. Golden,[3] in 1926, described a method of taking impressions of the face of patients by spraying molten wax with the aid of a sprayer operated by warm air. This method will be considered later. Poller's[4] plastic hydrocolloid composition, known as "negocoll," has attracted considerable attention owing to the elastic quality of this material, which is used for negatives. Clarke,[5] in 1935, in a comprehensive article, discussed the fundamentals of taking impressions and making casts.

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From the Mayo Foundation Museum of Hygiene and Medicine, The Mayo Clinic.

Although photographs are easier to make and less expensive than casts, one must admit that they lack the three-dimensional quality, which is so essential in orthodontic procedures. Casts, in the "round," using the sculptor's term, when used as guides, afford the opportunity of study from all angles. Procedures of treatment can be outlined on them at greater freedom than would be possible while the patient is in the chair. Furthermore, a careful study of casts in the office will often reveal conditions which may escape detection in the flesh.

Before describing the detail of a technic which I have found to be satisfactory in making a facial cast, I wish to review some of the fundamental considerations so that the various technics that have been suggested may be properly evaluated.

Table 1.—Ingredients of Proprietary Agar Preparations

	Gm.
Agar	1,000
Water	20,000
Cellulose	200
Iron oxide	500
Long fibers	10
Para rubber (not including weight of solvent)	250

TAKING THE IMPRESSION

Many kinds of materials can be used for impression taking. The more common ones are (1) plaster of Paris; (2) agar compounds and the so-called hydrocolloidal materials which are sold under the trade names of negocoll, dentocoll, form-all, etc., and (3) wax, the use of which was described by Golden.[3, 6] Three important factors in determining which one of these materials should be used for a facial cast are (1) the condition of the surface of the face; (2) the degree of undercuts, and (3) the nature of the material to be used for the positive cast.

The advantages of plaster of Paris are as follows: 1. The preparation of the plaster of Paris "mix" requires only one to three minutes, and from ten to fifteen minutes is required for the "mix" to set, which is a decided advantage. 2. There is no fear of distortion of the plaster mold after it has been removed from the face, and the impression contains minute detail. The mold can be kept indefinitely. The slight amount of distortion of the adipose tissues of the face produced by the weight of the wet plaster can, to a great extent, be prevented by avoiding application of too heavy layers of plaster at one time. 3. When wax is poured into plaster molds to obtain the cast, no separating medium will be required. If the mold does not include the ears, it can be separated from the wax positive in one piece. If a cast to include the ears is desired, a three-piece mold should be made in plaster. 4. Plaster negatives can be stored away for future use, as, for example, when a duplicate cast may be needed.

Table 2.—Clark's Formula for Agar Molds

		Gm.
Agar	4 ounces	113.2
Water	100 ounces	2830.0
Zinc oxide	1 ounce	28.3
Tannic acid	100 grains	6.5
Thymol	20 grains	1.3
Glycerin	1 ounce	28.3
Cellulose	½ ounce	14.1
Cotton	15 grains	1.0
Rubber cement	4 ounces	113.2

The disadvantages of plaster of Paris are as follows:

1. Plaster of Paris is not suitable for undercuts, especially if one desires to save the mold. If the cast contains too many undercuts, the mold must be chipped off. However, if one does not wish to chip the plaster mold, the so-called soluble plasters which contain powdered starch may be used. Immersing the cast and the mold in boiling water will disintegrate the mold, while the plaster cast will remain unharmed.

2. Plaster of Paris is not suitable for intra-oral lesions or lesions about the face, because of the danger involved in direct application of plaster of Paris to these parts.

Agar Molds.—The preparations of agar sold on the market under the various trade names, such as negocoll, dentocoll and form-all, contain, according to Clarke, who has examined the British patent specifications for negocoll, the ingredients given in Table 1.

Clarke gave the formula in Table 2 for preparing agar molds.

The advantages of agar molds are as follows: 1. They are suitable for taking impressions of intra-oral lesions. It is possible to obtain accurate impressions of

Fig. 1.—Equipment table and its contents.

Fig. 2.—Method of placing towels around face.

open wounds, nostrils and similar areas in which the use of plaster of Paris would be contraindicated. 2. Undercuts can be taken care of easily with one-piece molds. 3. Open eyelids can be included in the impression. 4. Molten wax can be poured into agar molds without ruining the mold, which is a distinct advantage.

I have used this material on many occasions when plaster of Paris could not be used and am convinced that there is a place for it.

The disadvantages of agar molds are as follows: 1. Their preparation is time-consuming. In obtaining an impression of the face, the agar must be melted first in a double boiler, which takes an hour or more. 2. After one layer has been applied to the face, it must be reinforced with a layer of plaster of Paris or some other rigid material to retain the shape of the mold.

Wax Spray Method.—This method, which was described by Golden,[6] consists of spraying molten paraffin over the face with the use of an air gun. The layer of molten wax coming in contact with the face at one time is so thin that the patient does not experience any discomfort. The advantages of this method are as follows: 1. It will not cause the least distortion of the soft tissues of the face, such as might occur with the use of too heavy layers of plaster of Paris or agar. 2. It is admirably suited for making ordinary plaster or stone casts.

The disadvantages of this method are these:

1. The technic requires equipment, considerable preliminary preparation and experience on the part of the operator before a cast can be made. 2. There is some shrinkage of wax, which must be taken into consideration. 3. It is not suitable for making a positive cast with a wax compound, especially when the latter has to be poured.

However, I believe that Golden's[3, 6] method for taking impressions of the

face by the spray method has its merits.

In the second phase of the making of the cast, one also has a choice of two basic substances: (1) plaster of Paris and its many derivatives, such as stones, and (2) mixtures containing wax, paraffin and rosin.

It is naturally a good plan to know which one of these is to be used for the final facial cast before proceeding with the preparation of the mold, because although it is possible to make a plaster of Paris cast from a plaster mold, it is difficult to obtain a wax cast from "wax spray" molds.

Plaster of Paris or hard plaster stone is suitable for durable casts, casts that will stand rough handling and washing. However, no degree of skilful coloring or tinting will make a plaster cast look lifelike, because plaster is opaque and living tissue is translucent. Wax mixtures are ideal for coloring because when mixed with other substances, they can be made to resemble tissue in translucency. I do not know of any other material that will permit of so easy manipulation and, at the same time, give such lifelike reproductions as wax. These compositions can be easily poured into the plaster negatives or agar negatives, and will separate without the use of any separating medium.

A quick and simple method of taking an impression with plaster and making a cast in wax, which may be employed by one person or with the aid of an assistant, is as follows:

One should prepare an equipment

Fig. 3.—Area to be included in cast, and application of vaseline to eyebrows.

Fig. 4.—First step in applying thin mix of plaster of Paris with brush.

Fig. 5.—Method of applying thicker layer of plaster of Paris over face.

Fig. 6.—Method of allowing suitable openings around nostrils.

table (Fig. 1) containing the following articles:

One large (5 inches in diameter) rubber plaster bowl
Two one-inch camel's hair brushes
Six tongue depressors
Two medium-sized spoons
One box of pins
One wax carver
One tube of vaselin
Quick-setting plaster of Paris

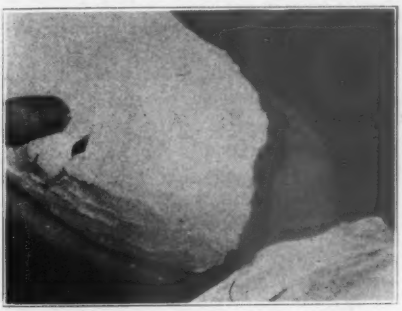

Fig. 7.—Method of removing hardened cast from face.

Fig. 8.—Method of leveling periphery of cast.

The face should be prepared in the following manner: The patient is placed in the dental chair, which is tilted so that the patient's face is almost on the horizontal. A small pillow placed under the head and neck will add to the comfort of the patient. The portion of the face which is to be reproduced must be separated from the rest of the face. This is done by enclosing the area to be included in the cast with folded plain towels (Fig. 2). One towel is placed on the forehead, 2 or 3 inches beyond the hairline; one is placed just below the chin, in the region of the hyoid bone, and one is placed on each temple in front of and just over the external auditory meatus. The four towels, which form almost a quadrangle, must be pinned at four corners to remain in place. Now all the visible hair within the area to be included in the cast must be protected with vaselin or a similar product. A generous amount of hair on the forehead can be included in the cast, provided it is well covered with vaselin. The eyebrows and eyelashes must also be gone over with this material (Fig. 3). During this preparation, it is advisable to in-

Fig. 9.—Cast being soaked in water.

Fig. 10.—Method of applying first layer of molten wax composition to inner surface of mold.

struct the patient regarding what he should expect. If the patient is of a nervous type, it is a good plan to acquaint him with the "feel" of the wet plaster by making an experimental cast of a small portion of the face. The patient must be instructed to lie calmly and to breathe slowly. Above all, the patient should be cautioned not to open his mouth. The excessive salivary secretion resulting from the presence of the wet plaster on the face must be swallowed before the plaster cast hardens.

Sufficient mixed plaster to fill a 5-inch rubber bowl is enough to cover the entire face. A rather quick-setting dental plaster, mixed to a creamy consistency, is held near the face by an assistant. The first step is to paint the face, with the exception of the hairy areas, with this creamy plaster (Fig. 4). This preliminary painting of the face with a camel's hair brush should take only a minute or so, the time depending on the setting speed of the plaster. At the end of this time, the consistency of the plaster will have become such that it can be "flowed" over the face with a spoon and will not run down the face. In "flowing" the plaster over the face, it is best to make it run in such a direction that it will flatten the hairs of the eyebrows in a downward direction, especially the eyelashes (Fig. 5). Such precaution will prevent the eyelashes from being embedded in the hardened plaster.

If one is making a cast for the first time, a soft rubber tube should be inserted in each nostril to allow for breathing. However, after a little experience, one can do away with the use of these tubes. By careful manipulation of the plaster, suitable openings can be left around the nostrils. This will enable one to obtain an undistorted impression of the *alae nasi*, an important anatomic feature (Fig. 6).

After this operation, the consistency of the plaster will have become such that it can be shaped over the face with the use of a spatula or a tongue depressor. In doing this, attention must be given to reinforcing the periphery of the cast so that it will not crack when being removed from the face.

As soon as the plaster has begun to show signs of hardening, which is evidenced by the generation of heat, it must be removed from the face without delay (Fig. 7). Otherwise, the heat of the setting plaster might cause some injury to the face, especially if the skin is of a sensitive type. At this stage, the plaster, although not adherent to the face, is held tightly against it because of atmospheric pressure. In gradually pulling the mold away from the face, this fact must be remembered. Asking the patient

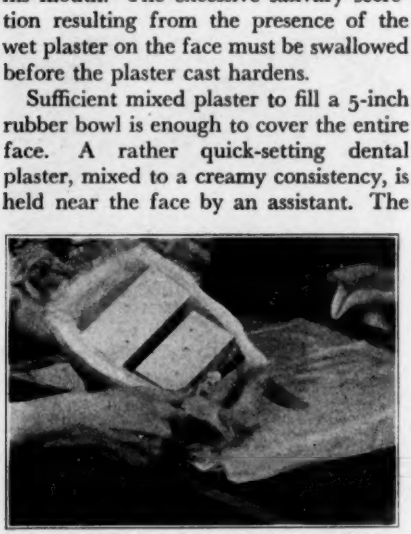

Fig. 11.—Trimming excess of wax from around periphery of mold with knife.

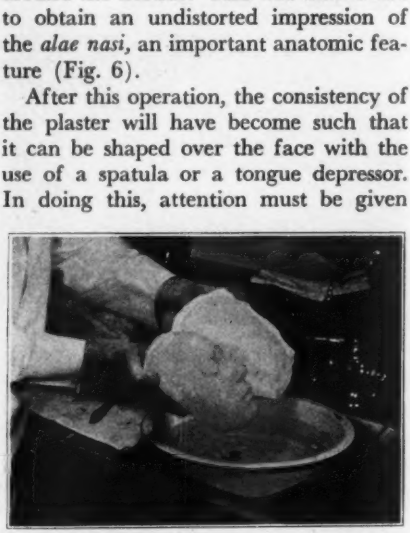

Fig. 12.—Method of separating cast from mold.

to move the facial muscles usually will aid in the separation. It is important to instruct the patient to keep his eyes closed when the plaster cast is being removed, because of the danger of small chips of plaster falling into his eyes.

The plaster impression, after it has been removed from the face, is carefully examined for any defects and these are mended with plaster, preferably while the mold is fresh. The openings in front of the nostrils are also filled with plaster. The periphery of the cast is then trimmed and leveled with the aid of a piece of plateglass (Fig. 8).

The plaster mold, if fresh, is then soaked in water for a few minutes, and if dry, for a half hour (Fig. 9). It is now

Fig. 13.—Cast just as it comes out of mold, compared with face of patient.

ready for the pouring of the wax, which forms a positive cast. Before pouring the wax, all visible water on the surface of the plaster must be removed with a clean piece of cheesecloth.

A suitable mixture of wax, which is ideal for pouring and which is a modification of a formula used by Gottheil, contains the following ingredients:

Bleached beeswax, 2 pounds (900 gm.)
Paraffin, 1 pound (450 gm.)
Talcum (white), 1 pound (450 gm.)
Cornstarch, 1 pound (450 gm.)

Beeswax has a high softening point, and the use of it in this proportion will raise the softening point of the mixture. Although paraffin has a low softening point, it must be added to prevent the mixture from cracking on solidification. Talcum and cornstarch act simply as a filler and decrease the transparency of the mixture. The formula may be varied by decreasing or increasing the proportion of these fillers according to the degree of translucency desired. For example, if bony structures are to be cast, it is advisable to double the amounts of cornstarch and talcum and thus obtain a material which is almost opaque. Pouring is done repeatedly, in and out, each time a small amount of the mixture congeals in the mold. The first layer is the most important one. Here, one must be sure that no free water is in the mold and that a generous amount of wax mixture is poured in. The mold is immediately rotated and rocked in different directions in such a way that the wax will cover the entire surface of the cast (Fig. 10). Failure to do this successfully will result in crease lines which it is difficult to eliminate. The subsequent layers can be poured more slowly than the first layer. After about three quarters inch (1.9 cm.) of wax has adhered to the inside of the mold, it must be reinforced with wood blocks, which should be prepared before the pouring is commenced. They must be fused in position with additional hot wax and the edges trimmed with a pallet knife (Fig. 11).

The entire cast can now be immersed in cold water for two or three minutes to hasten the hardening of the wax. At this stage, one will usually note a tiny cleavage line appearing between the plaster mold and the wax cast, which indicates that the two have already separated. Careful pulling of the wax away from the mold will complete the separation (Fig. 12). Imperfections on the final cast (Fig. 13) should be touched up

with a wax spatula and with some wax solvent, such as xylene, benzene or turpentine judicially used.

COLORING THE WAX CAST

If the casts are to be used only in orthodontic cases, coloring is not important. One may add to the mixture of wax a small quantity of coloring matter, such as yellow ocher; or small quantities of yellow beeswax may be added.

Coloring the wax cast, to make it resemble the color of the face, is done as follows: The entire cast first is painted with poppy seed oil by using a wide camel's hair brush. The oil acts as a medium on which to spread the oil pigments, which must be applied with great discrimination and care. Experience and careful study of colors present on the face will enable the worker to produce a lifelike replica. The paint must be dabbed on with the brush; it should not be stroked on. The cast must be tinted rather than painted. Although poppy seed oil dries slowly, it will begin to thicken in a few hours. This makes it difficult to distribute the pigments evenly. Therefore, the work must be done at one time. The oil will dry with a dull finish.

SUMMARY

Casts of the face are useful guides in those branches of medicine and dentistry in which an authentic reproduction of existing conditions of the face is desired. Such reproductions aid the operator in planning the procedure of treatment and afford him a means of comparing the results following treatment.

Of the three common types of impression materials, namely, plaster of Paris, the agar preparations and the wax, plaster of Paris is the quickest and the simplest to use. Agar preparations and the wax spray methods may be used to advantage in special cases. The mixture that has been described has a translucency similar to that of tissue. Tinting will produce lifelike reproductions.

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The Mayo Clinic.

REQUIREMENTS OF THE JACKET CROWN

By E. Bruce Clark, D.D.S., Pittsburgh, Pa.

THIS year marks the one hundredth anniversary of the use of translucent porcelain in dentistry. Prior to 1838, dental porcelain was an opaque white material resembling that used in industrial ceramics. During that year, Elias Wildman formulated a translucent porcelain which he was able to produce in colors similar to those of natural teeth. Artificial teeth, then known as mineral teeth, were made from this new material, and soon afterward a porcelain was developed for denture bases.

For fifty years following Dr. Wildman's work, the use of dental porcelain was confined almost exclusively to the field of artificial dentures. The dental ceramic art, as it is employed today, existed only as a vision of the dreamer. The basic principles of its application to restorative dentistry had not been discovered. Since constant failure confronted the men searching for a method of application, little progress was made.

Finally, one determined investigator demonstrated the use of platinum as a basis for the construction of porcelain inlays and crowns, and the profession immediately recognized the solution of the problem. This benefactor, as you all know, was Charles H. Land, who not only conceived the principle of using platinum foil as a matrix material, but also designed the various restorations made possible by its use. And the most amazing feature of Dr. Land's method is that, after fifty years of application, no one has been able to improve it.

The Land crown, as described by Dr. Capon,[1] "consisted of a frame or sheath of platinum covering the prepared tooth, with a porcelain veneer fused to the labial surface, leaving the lingual surface exposed, the platinum and the whole shell being cemented to place." In the years that followed, Dr. Land modified his original design to meet almost every condition in the mouth where a crown was indicated. Finally, in 1902, he gave the profession a method for constructing an all-porcelain jacket crown, and today we are using precisely the same method without variation. This is also true of the porcelain inlay, notwithstanding the many attempts that have been made to discard the platinum matrix. Improvements have been made in materials and technic, but none in method.

The all-porcelain jacket crown, when skilfully executed, meets requirements better than any other dental restoration. Its requirements are four: It must preserve the vitality of the tooth; it must maintain the health of the investing tissues; it must restore the tooth to normal function, and, finally, it must meet the requirements of esthetics.

The first requirement of a jacket is that it preserve the vitality of the tooth. No one doubts that porcelain is an excellent nonconductor in the presence of thermal changes and similar stimuli that are often irritating to the pulp. Time has proved the fallacy of the belief that "teeth must breathe" to remain healthy. Instead, we find an advantage in the fact that a jacket envelops the

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entire crown of a tooth in that it prevents pulp involvement from recurrent decay. So it follows that this first requirement is one of operative technic rather than of the finished crown itself. In other words, if the case is carefully selected and the preparation skilfully executed, the vitality of the tooth is virtually assured.

The selection of cases among adult patients presents few problems unless the tooth in question is malformed or is in abnormal alinement. When these exceptions occur, the position and size of the pulp should be determined roentgenographically and the preparation made accordingly. The same precaution should be taken for younger patients and especially in fractured anterior teeth, since the health of the pulp is always in question after the injury. It might be well to note that death of the pulp is more likely to occur from traumatic injury when the tooth does not fracture; for, in these cases, the root is required to absorb the entire force of the blow; whereas, in fractured teeth, a portion of the tooth gives way and the force is carried through. Fractured surfaces should be well protected and permanent restorations should be delayed until the health of the pulp has been definitely determined.

Pulp recession in normal permanent teeth is fairly uniform in relation to the age of the patient. In abnormalities such as hypoplasia of the teeth and other conditions in which jackets might be indicated, pulp recession may often be retarded when one might expect it to be advanced. For this reason, it is difficult to place a minimum age limit for jacket restorations. I have been less conservative in this respect than many of my predecessors and, after a recent survey of early cases, I believe justly so. Two years ago, I was fortunate in being able to recall sufficient patients to permit an examination of thirty-eight jacket crowns that I had made for young patients eighteen years ago. Six of these crowns were placed in patients 14 years of age, sixteen at 15 years of age and the remainder at ages varying from 16 to 20 years. All of the teeth were of course roentgenographed. All were apparently vital except one. Fifteen of the thirty-eight crowns were removed and replaced. All of the teeth were normal clinically and fourteen of the fifteen required a local anesthetic for the refinement of the preparation. The fact that these jacket preparations were the very first made by a recent graduate of not more than average ability and with no instructions whatever is convincing evidence of the superiority of this restoration in preserving the vitality of pulp tissue.

The devitalization of the one tooth mentioned resulted from injury to the pulp during preparation. I can distinctly remember having cut so deeply into the distal surface of the tooth that I could see "pink," and although an attempt was made to protect the surface, the pulp died one year later.

TREATMENT PLANNING

Injury to pulp and investing tissues can be avoided by careful operative technic and by predetermining the exact operative procedure that is indicated for the case. By this, I mean to predetermine whether all of the enamel should be removed and whether a shoulder should be used and, if used, where it should be placed.

To aid in making an intelligent decision regarding these factors, the relationship between gingiva and tooth surface should be clearly understood. Kronfeld[2] says,

> Prior to 1921, this relationship was described thus: The gingival tissue is normally attached to the tooth at the cemento-enamel junction (gingival line) and it remains there unless there is some pathologic interference. The work of Gottlieb, Orban, Skillen, Muel-

ler, Becks, Bodecker and many others has demonstrated that this old concept of the attachment of the free gingiva at the gingival line is incorrect. Gottlieb showed that at the time a tooth begins to erupt, most of the enamel is still in organic union with the epithelial tissue left over from the original enamel organ. He called this tissue, which is attached to the still unerupted part of the enamel, the epithelial attachment. Gottlieb also showed that at no time during life is the location of the gingival crevice on the tooth surface stationary. In youth, the bottom of the crevice is located on the enamel. With advancing age, it gradually moves rootwise, going beyond the cemento-enamel junction, so that a portion of the root is exposed. . . .

Ten or even five years ago, such a discussion would have been fruitless because of the small number of good human specimens available at that time. Since then, dozens of shallow, intact human gingival crevices of persons of all ages have been studied microscopically, and the gradual rootward displacement of the bottom of the gingival crevice is so obvious in these specimens that it is hard to believe that this could be anything but a physiologic process.

I have been unable to find any histologic report of observations made on the possible reattachment of the gum tissue to enamel when the epithelial attachment has been broken. My own clinical observations lead me to believe that it does not become reattached, and I have further observed in many cases that the gum tissue recedes in advance of the normal recession when the epithelial attachment has been injured. It is therefore not difficult to foresee what would result if all the enamel were removed in the preparation of a jacket crown for a tooth when the epithelial attachment is still present. These cases definitely call for the removal of enamel from the clinical crown only, which is that portion of the tooth that is exposed.

When recession has progressed to such a degree that the tissue attachment is beyond the cemento-enamel junction and on cementum only, it is quite permissible to remove all of the enamel and place a shoulder in dentin. This, of course, necessitates the removal of as much dentin from the gingival half of the prepared tooth as there is depth of shoulder, but since this condition exists only in older patients in whom pulp recession can be expected, little, if any, injury to the pulp will result.

Conservation of tooth structure is, of course, more important in the young patient. It can be effected more advantageously by the use of a shoulder in the enamel in all cases where the tissue attachment is on the enamel. Oppice[8] has examined many ground sections of permanent teeth and has observed that there is no bulge or bell shape of the dentin. It thus follows that it is quite possible to place a shoulder in the enamel without the sacrifice of dentin, provided the shoulder is made no deeper than the thickness of enamel. The enamel, of course, becomes thinner as the cemento-enamel junction is approached, so that a shoulder of average depth near the gingival line might require the sacrifice of a little dentin, but it must be remembered that as the soft tissue recedes, the element of danger is becoming less and less because the patient is growing older.

There is considerable diversity of opinion in respect to the relationship of the shoulder to the gingival crevice. Some suggest placing the shoulder "just beneath the free gum margin"; others extend it as near to the attachment as possible. It is difficult to formulate a definite rule for this procedure since the depth of the gingival crevice will vary from 0.5 to 2 mm. on the same tooth, as well as in different cases. It is therefore good policy to explore the crevice with a flat blunt instrument to determine its depth at different points. The findings will serve as a guide. When it is possible to place the shoulder well beneath the free gum line without danger of injury to the attachment, I prefer to do so.

When the crevice is shallow, the shoulder can usually be placed to one-half its depth with safety.

It is not always essential that the shoulder be carried even to the gum line. In certain cases, it is advantageous to place it on the buccal or lingual surface of the tooth at or near the junction of the gingival third with the middle third area. This procedure is more often indicated in the lower bicuspid and molar regions, especially when the teeth have sufficient length or when the vertical dimension is being increased. It is also often advantageous in the anterior region, when the cingulum is large and prominent, to place the shoulder on the lingual surface just incisally to the cingulum. By keeping the shoulder at a right angle with the tooth surface in this area, an acute angle is formed which may add materially to the support of the crown.

Just how much support is afforded the crown by the angle of the shoulder is questionable. A right angle shoulder is the easiest type to prepare correctly and is more favorable to an accurate construction of a porcelain union or joint, but the long and successful use of shoulderless crowns seems to challenge its usefulness as a supporting medium. Shoulderless crowns undoubtedly have merit and they are indicated on teeth that have exceptionally narrow necks, where the preparation of the shoulder would not only encroach on the pulp tissue, but would weaken the structure of the tooth as well. These cases may also be handled successfully by the use of a casting on which an artificial shoulder has been developed.

PREPARATION

The form of the remainder of the preparation incisally to the shoulder should be that of the normal form of the dentin when all of the enamel is removed. This, of course, is almost identical to the form of the clinical crown, except that there are no bulges or bell-shaped contours. Cusp form will then have been reproduced on bicuspids and molars, which is most essential in preventing fracture from masticating force.

In anterior preparations, there should be sufficient length to prevent crescent-shaped fractures at the gum line and sufficient width to prevent fracture from torque. These two requirements cannot always be met where there is considerable loss of the tooth structure, and it then becomes necessary to make a thimble casting restoring that portion of the tooth that has been lost. The incisal edge in anterior preparations should be beveled slightly at a right angle to the line of masticating force when the teeth are in normal occlusion. In edge-to-edge bites, the preparation should receive an incisal groove similar to that used in a three-quarter crown preparation.

Injury to the pulp tissue can easily occur during the process of preparation if care is not given the technic. Less heat will be generated if soft rapidly cutting stones and disks are used, and these, including sandpaper disks, never used except under a copious stream of water. I hesitate to mention the use of air from a syringe or chip-blower for fear my observations are not well founded. However, at the moment, I believe that air used to keep the field of vision clear during the preparation and refinement of the shoulder is a source of irritation and I prefer to use a mixture of warm water and air from the spray-bottle for this purpose; or when air alone is necessary, to use it cautiously.

Further irritation to the pulp can be avoided by making the toilet of the preparation while the anesthetic is still effective and before the band impression has been taken. The exposed surface of the dentin should be washed free of saliva, sterilized and dried with a solution of alcohol and chloroform, three to one.

The alcohol acts as a dehydrating agent and the chloroform will dissolve any fatty substance on the tooth surface. The preparation is then varnished with copalite for the protection of the exposed dentinal tubuli. Before permitting the tooth to become wet, all undercuts resulting from deep cavities not eliminated in the preparation should be filled with a hard inlay wax and the preparation lubricated.

TISSUE PROTECTION

When sufficient protection has been given to the exposed surface of the dentin, there is little possibility of pulp irritation from pressure exerted during the procedure of taking the band impression. Injury to the gum tissue attachments, however, may and often does occur unless precautions are taken. When the sharp edge of the copper band severs the attachment, repair will usually follow if the attachment is on cementum; but when it is on enamel, premature recession of the gums will result in many cases.

This type of injury may be prevented if a band is selected which is large enough to pass over the stump, but too small to pass over the shoulder. It is then festooned so that the edge contacts the shoulder in its entire circumference. After annealing, the peripheral edge of the band is stretched just sufficiently to be permitted to pass over the shoulder. The flare given the edge of the band in stretching will help prevent its being forced into the tissues.

The impression is then taken in the usual manner, it not being necessary to secure a satisfactory impression at the first attempt. After chilling and removing, the impression is examined for imperfections. Additional festooning of the edge may be carried out at this time if necessary, or any similar corrections be made. The real value and accuracy of this technic, which has been suggested by McClung,[4] lies in the remaining steps. Without reheating, the band is now replaced on the prepared tooth. While finger pressure is exerted on the exposed end of the band, a large ball burnisher is heated and applied to the buccal and lingual surfaces until the impression material is just sufficiently heated to permit its being forced to place. Since this procedure can be repeated as often as is necessary, it gives the operator excellent control of the extent of the band over the edge of the shoulder, thus preventing injury to the soft tissues.

Adequate protection should be given the stump and gum tissue while the crown is under construction. One or two strands of cotton string saturated with surgical cement and tucked beneath the gums will hold them away from the shoulder and act as a healing sedative. The prepared tooth should be varnished with a nitrocellulose cavity lining and a temporary tooth be made of silicate cement.

If the jacket is not to be completed for the second sitting, the silicate tooth can be made removable by first lubricating the prepared tooth stump before the cement is applied. As the cement tooth is setting, it should be removed and replaced several times to prevent adhesion, and when finally set can be secured in place with surgical cement.

FUNCTION

The remaining requirements of a jacket crown, with the exception of color selection of cement as well as of porcelain, are developed in the laboratory. In order that the crown may function to the best advantage, it must have correct occlusal relations and properly contoured surfaces. In order that the crown will appear to the best advantage esthetically, its exposed surfaces should reproduce in detail the surface markings characteristic of that mouth. These are all laboratory steps that can be executed

satisfactorily only with the aid of a perfect impression for a working model.

Full mouth impressions are necessary when the crown is a molar, bicuspid, cuspid or lower incisor. When the bite is normal, the occlusal relations of the upper incisors can be established in the mouth after the crown has been completed.

Plaster of Paris seems to be the popular material for these impressions. Unfortunately, only the most skilled operators are able to secure all necessary contours and surface markings with this material. For the rest of us, the hydrocolloids meet the requirements more successfully and with much less difficulty, and they do not require a second impression of the prepared tooth or any other aid for the transfer of the relationship of the stump of the approximating teeth. If two small rolls of utility wax are placed on the rims of the impression trays opposite the area of preparation, they will form a foundation through which a toothpick can be passed, approximating the root of the die. The die is then waxed to the toothpick, which will hold it securely in place while the impression is being run.

FORM AND COLOR

With an accurate working model, the reproduction of the tooth form is a simple procedure, consisting of copying another tooth, changing it from a right to a left, or vice versa, and then placing it in proper alinement and occlusion. Outline form and contours are sometimes modified to produce an optical illusion, such as a flat surface to make the crown look wider and a severe contour to make it appear narrow.

To meet the requirements of esthetics, tooth color must be reproduced as well as tooth form. Unfortunately, tooth color requirements are difficult to meet because there are so many factors that must be coordinated before a satisfactory result can be secured. If natural tooth structure and dental porcelains were materials identical in physical characteristics, the problem would be simplified.

Just how physical differences in different materials influence their color may be illustrated by comparing a piece of woolen cloth with a piece of silk. They may be identical in color, but they do not look alike. The size and texture of the thread is different, the weave is different, the surface characteristics and the luster are different, and because of these physical differences, the two materials cannot appear to be of the same color even though their color measurements are identical. The physical characteristics of two different materials must appear the same before a color match can be made.

In imitating the physical characteristics of tooth structure with porcelain, assuming that the porcelain is well condensed, we are confronted with three principal factors that must be reproduced before we can hope to get a good color match. They are surface character or markings, surface luster and degree of translucency.

Surface markings should be reproduced on the jacket just as they occur on the natural tooth in order that light shall be reflected from all in the same manner. This will permit highlights and shadows to occur in identical areas at the same time.

Surface luster, a more important characteristic, should be identical so that incident light will be equally diffused and reflected in like amounts; otherwise, the color will change under different sources of illumination. The correct luster of a jacket cannot always be established by glazing alone, it being necessary in many cases to complete the finish by polishing with a wet rag wheel and pumice. Polishing is especially necessary where the maximum amount of opacity is required, since a certain amount is lost when the crown is fired to a high glaze.

Surface markings and luster are easily reproduced, but the third factor, the degree of translucency, is in many cases a most vexing problem. If the translucency of all natural teeth were the same and if there were no difference in the translucency of the different areas of the same tooth, we should have less difficulty, but unfortunately there is a wide variation. Teeth of different individuals vary in translucency in accordance with their size and shape and density of enamel. Different areas of the same tooth vary in translucency, principally in accordance with the thickness of the tooth buccolingually, the incisal edges of thin teeth being most translucent. Since teeth are more or less wedge-shaped, the translucency diminishes and the color becomes more opaque as the gum line is approached.

Now, in contradistinction to these natural conditions, dental ceramic porcelain is furnished by the manufacturers in one degree of translucency only, and, with this material, we are required to construct a crown of varying translucencies throughout its entire length. Since porcelains of different manufacturers and of different fusing temperatures vary somewhat in translucency, some are more suitable for gingival colors, whereas others are advantageous when used as incisal colors. However, the use of different porcelains in the same crown is not advisable and, in fact, in most instances impossible.

Since one type of porcelain when used alone will not meet the requirements of translucency throughout the crown, these differences must be established by some other means. And this is not an easy matter, unless every possible factor is understood so that it can be made use of as the case demands. I have always found it easier to make a translucent porcelain appear more opaque than to make an opaque porcelain appear more translucent. Therefore, I prefer to use as a basic material the most translucent porcelain available, because with it one can almost invariably match the middle third area of the tooth by varying the degree of firing. When greater opacity is required, the firing time is reduced and the final luster secured by polishing. The translucency may be increased within certain limits by increasing the firing time. These requirements should be determined when the shade is taken.

When this type of porcelain is used, the gingival area will usually require opacification, which may be accomplished by using opaque porcelain for a ground coat over the matrix; or it may be controlled in part by the use of oxyphosphate cement for setting the crown. Since the opacity established by the cement is, of course, a constant factor, in its use, variations must be secured by varying the thickness of the labial wall of the crown and the color of the porcelain. A thin wall or a strong color will increase the opacity. A thick wall and a grayer shade will decrease opacity and make the area appear more translucent.

The natural translucency of the translucent porcelains will sometimes meet the requirements of the incisal third area without alteration, if the color is carefully selected. Here again, the grayer shades appear more translucent. However, when blue lines or blotches of an almost transparent nature appear near the incisal edge, they must be imitated in the crown with stains or transparent porcelain. When high fusing stains of proper color and concentration are applied in thin applications and fired into the surface of the crown during the final or glazing bake, the results are very gratifying. Since the transparent porcelains are a little more transparent than the areas in natural teeth, they must be used sparingly.

Before the shade is selected, it is advantageous to determine what procedure

shall be used in the particular case to secure the varying degrees of translucency so that colors most adaptable to these variations can be selected. Color selection has three essential requirements: 1. The illuminating light should be sufficiently intense, well diffused and of proper quality or color. 2. The operator should be provided with samples or shade guide teeth sufficient in number to cover the entire field of tooth color. 3. The attributes or dimensions of color should be well understood so that one quality will not be mistaken for another.

The attributes of color are three in number. A color cannot be described without reference to all three of them, if the color contains a hue as does tooth color. Therefore, it follows that in matching tooth colors, these attributes are indispensable, because the color must match in all three dimensions.

When a color does not match in respect to the first attribute, it is either too light or too dark. In other words, the color appears to contain too much white or not enough.

A color does not match in respect to the second attribute when it is too strong or too weak. In reference to tooth color, it is too strong when it contains too much yellow and too weak when it contains too much gray.

A third attribute has to do with the hue of the yellow. When it does not match, it is either too red or too green a yellow. When one becomes familiar with these attributes of color, he is no longer confronted with the troublesome problem of knowing that there is something wrong with the color, but not knowing what it is.

CEMENTATION

Familiarity with the attributes of color is also invaluable in blending cements for setting the crown. The amount of influence that the color of the cement will have on the color of the finished crown depends on the translucency and thickness of the porcelain as well as the type of cement used. The use of semitransparent cements, such as kryptex, has the least effect and they require little blending. The oxyphosphate cements, because they are opaque, have a decided bearing on the final color of the crown and must be carefully selected and blended.

There are several advantages in the use of oxyphosphate cement aside from its superior retentive qualities. As mentioned before, it affords a method of increasing opacity of the gingival third area of the crown. When an error has occurred in the selection of porcelain colors, it can often be corrected by the color of the cement, and thus remaking be obviated. Finally, an opaque cement gives us a means of dealing with other physical characteristics of natural teeth.

The "liveliness" of color in vital natural teeth can be imitated in the jacket crown by increasing the reflecting power of the substructure. This is done by the use of oxyphosphate cement for setting the crown, giving it an internal reflecting medium which returns most of the light that reaches it through the wall of porcelain. The reflectivity of the cement compensates for the lack of vitality in the porcelain. It must be remembered that it will increase the strength or saturation of the color as well, so that when the porcelain colors are selected, it is best to choose a color slightly grayer than the gingival area of the natural tooth. Reflectivity is increased by using light, saturated cement colors and decreased by the use of dark grays. It is therefore preferable to select porcelain that will permit the use of the lighter and stronger cement colors.

In connection with the setting of the crown, there is one other factor to be considered. When the crown occludes with the natural teeth or other porcelain teeth, the glaze should be removed from the chewing surface in order to facilitate

occlusal wear. When the crown occludes with gold, the glaze should be left intact, and thus excessive wear of the softer gold surface be prevented.

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635 Union Trust Building.

AN ANALYSIS OF THE VERTICAL DIMENSION AND THE POSITIONING OF PROSTHETIC POSTERIOR TEETH IN FULL DENTURE CONSTRUCTION

By Barnett Kessler, D.D.S., New York City

ANALYSIS OF THE VERTICAL DIMENSION

The purpose of this paper is to present some recent viewpoints on two phases of the full denture problem with the desire of clarifying our understanding of the subject. The vertical dimension shall be considered first, followed by a method of positioning anatomic prosthetic posterior teeth.

The vertical dimension in full denture construction generally refers to the intermaxillary opening arbitrarily established in order to build dentures. An example of a classic formula that proposes an acceptable dimensional record reads as follows:

1. Subnormal resorption $\frac{3}{8}$ inch. (Resorption following recent extractions).
2. Average resorption $\frac{5}{8}$ inch. (Full shrinkage).
3. Abnormal resorption $\frac{7}{8}$ inch. (Lower ridge flat).
4. Extreme resorption 1-$1\frac{1}{8}$ inch. (Lower ridge flat and upper ridge soft).

This linear concept is hardly adequate, for the problem is a three-dimensional one, and the cubic content of the denture space should be considered with a view to permitting normal physiologic function as far as is possible.

In the absence of any information on the approximate mean or average cubic content of the buccal cavity, a number of persons were subjected to tests, and the subjects were classified in three groups.

1. Cases presenting a full natural dentition.
2. Cases disclosing mixed dentitions; *i.e.*, those with several teeth missing and others with small fixed or removable bridges.
3. Edentulous cases having full dentures present.

The individuals were all subjected to the same tests, except that, with the edentulous cases, it was possible to remove the dentures and also to make comparative tests.

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The subjects were carefully selected for type and intelligence to insure fullest cooperation. Ages varied from 25 to 76 years. Each subject was instructed first to take a sufficient amount of water to comfortably fill the buccal cavity, with opposing teeth in contact and lips closed. The content was measured in a graduated decanter. A second test with the same relationship followed, but with the difference that the patient was instructed to take as much fluid as was possible. This, too, was measured and recorded as indicated. (Tables 1, 2 and 3.)

It appears evident that any knowledge of the average cubic content of the mouth may aid in the solution of the denture problem. How can the best relationship be attained without any idea of what this is? It is suggested that further data on the buccal cavity content are necessary for a more accurate refinement of this estimated mean content. Explorations in this field may prove fruitful in revealing a cause of impediment of speech as a result of insufficient tongue accommodation.

Relative to closure of the vertical dimension, Oscar V. Batson, professor of anatomy, University of Pennsylvania, confirmed James B. Costen's findings, which he aptly termed "Costen's syndrome." He gives a plausible explanation for glossodynia (pain in the tongue) and paresthesia (numbness) characterized by "pins and needles" of the throat, frequently associated with closed bite cases. It is significant that Dr. Batson dismisses the mass of dental opinions and statements about the effects of closed dimensions on hearing as being without basis and devoid of any supporting or conclusive evidence to date, but definitely

TABLE 1.—DATA ON THE FLUID CUBIC CONTENT OF THE BUCCAL CAVITY: CASES WITH FULL PROSTHETIC DENTURES

A. Normal Content of Buccal Cavity*

Frequency in Fluid Ounces	Age											
	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	Total
½ — ¾	—	—	—	—	—	2	—	4	—	1	—	7
1 — 1¼	—	—	1	1	2	7	7	11	4	1	1	35
1½ — 1¾	—	3	—	—	3	5	—	2	1	—	—	14
1¾ — 2	1	—	3	1	—	—	—	—	—	—	—	5
2¼ — 2½	—	—	—	—	—	—	—	—	—	—	—	—
2½ — 2¾	—	—	—	—	—	—	—	—	—	—	—	—
Total	1	3	4	2	5	14	7	17	5	2	1	61

B. Maximum Content of Buccal Cavity

Frequency in Fluid Ounces	Age											
	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	Total
½ — ¾	—	—	—	—	—	—	—	—	—	—	—	—
1 — 1¼	—	—	—	—	—	1	1	5	—	1	—	8
1½ — 1¾	—	—	—	—	—	4	5	9	4	1	1	24
1¾ — 2	—	3	1	1	4	7	1	3	1	—	—	21
2¼ — 2½	1	—	3	1	1	2	—	—	—	—	—	8
2½ — 2¾	—	—	—	—	—	—	—	—	—	—	—	—
Total	1	3	4	2	5	14	7	17	5	2	1	61

*Normal indicates sufficient amount of water to fill the buccal cavity comfortably.

supports the contention regarding temporomandibular joint and tongue pains as caused by closures.

The effects of tongue crowding are clearly evidenced by tooth indentations on the peripheral margins of the tongue, which, in the absence of any designated name, I shall call *lingua dentoformata.* This is a typical example of the effects of physiologic functional interference. It is within the scope of the dentist to observe, record and correct such conditions, in order to avoid later and more harmful progressive changes.

The determining factors in the selection of a given opening are:

First, recency of full denture requirement. Immediate denture cases present valuable data on the gradual or rapid changes found in trauma or disease and effected to the present state of closure. For the greatest degree of patient comfort, it is a safe rule to increase openings, where necessary by stages. The ideal, not always practical, is to effect opening as gradually as it has been lost for the least amount of physiologic disturbance. It is common knowledge that the dental mechanism, like the rest of the body, is in a constant state of flux, due to the anabolic and katabolic activities that are present from the time of birth until death. Function and wear compel constant adjustments and biophysical alteration of a compensatory nature constantly affecting the form of the mechanism. To disregard such changes and empirically attempt to alter the masticatory apparatus must inevitably lead to some enlightening jolts.

Second, the condition and form of the intermaxillary ridges, which are combinations of concave, convex, flat or saddle shapes. Spongy, demineralized, sensitive and stringy ridges frequently indicate a vitamin C deficiency, as has been ob-

TABLE 2.—DATA ON THE FLUID CUBIC CONTENT OF THE BUCCAL CAVITY: CASES WITH FULL PROSTHETIC DENTURES REMOVED

A. Normal Content of Buccal Cavity

Frequency in Fluid Ounces	Age											
	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	Total
⅛ — ⅞	—	—	—	—	—	2	—	3	1	2	1	9
1 — 1¼	—	—	1	—	3	4	5	15	4	—	—	32
1⅜ — 1⅞	—	3	1	1	1	5	2	1	—	—	—	14
1¾ — 2	1	—	2	1	1	1	—	—	—	—	—	6
2⅛ — 2⅜	—	—	—	—	—	—	—	—	—	—	—	—
2½ — 2¾	—	—	—	—	—	—	—	—	—	—	—	—
Total	1	3	4	2	5	12	7	19	5	2	1	61

B. Maximum Content of Buccal Cavity

Frequency in Fluid Ounces	Age											
	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	Total
⅛ — ⅞	—	—	—	—	—	—	—	—	—	—	—	—
1 — 1¼	—	—	—	—	—	1	2	7	—	2	—	12
1⅜ — 1⅞	—	—	1	1	—	4	3	6	4	—	1	20
1¾ — 2	—	3	3	—	4	3	—	4	1	—	—	18
2⅛ — 2⅜	1	—	—	1	1	4	2	—	—	—	—	9
2½ — 2¾	—	—	—	—	—	2	—	—	—	—	—	2
Total	1	3	4	2	5	14	7	17	5	2	1	61

served by many, and more recently established by Paul E. Boyle *et al.* and by Craig D. Butler.

Third, the presence of full dentures, from which may be gleaned essential data—data that not only reveal what to do, but also what not to do. Information relative to the duration of wear from the initial edentulous period to the current opening should be requested from the patient. The degree of forward shift indicating dimensional loss may thereby be determined.

Fourth, the presence of dyscrasia or disease affecting tissue tone, such as cardiac problems, vascular disturbances, diabetes, nephritis and nutritional disharmonies. In questionable cases, an adequate medical report may obviate future embarrassment and prove of definite value in attaining the objective.

Fifth, roentgenographic examination is essential to disclose bone condition, concealed impactions, root fragments, foreign bodies, abscesses and sequestra.

Sixth, the consideration of esthetics. This was formerly considered the prime factor, but is now limited by modifying factors. In the correlation of esthetics and function, the latter should predominate for the well-being of the foundation, except in those cases wherein the nature of occupation or public position emphasizes the importance of appearance. In these cases, it may be preferable and pardonable to sacrifice loss of efficiency with its chain of progressive destruction for peace of mind resulting from a consciousness of improved appearance. The psychologic value of such compromise is generally appreciated. However, the desire to effect openings at 60 becoming those of 16 should be frankly discouraged. This concept, by the same reasoning, may be applied to modification of tooth form.

TABLE 3.—COMPARISON OF THE FLUID CUBIC CONTENT OF THE BUCCAL CAVITY

Frequency in Fluid Ounces	Cases with Full Prosthetic Dentures (61 Cases)				Cases with Mixed Dentures* (26 Cases)		Cases with Natural Dentures (26 Cases)	
	Content							
	With Dentures		Without Dentures		Content		Content	
	Normal	Maximum	Normal	Maximum	Normal	Maximum	Normal	Maximum
½ — ¾	7	—	9	—	2	—	3	—
1 — 1¼	35	8	32	12	13	—	6	1
1½ — 1¾	14	24	14	20	6	6	6	3
1¾ — 2	5	21	6	18	4	9	8	5
2¼ — 2½	—	8	—	9	1	5	2	6
2½ — 2¾	—	—	—	2	—	5	1	7
2¾ — 3⅛	—	—	—	—	—	1	—	2
3¼ — 3½	—	—	—	—	—	—	—	1
3⅝ — 3¾	—	—	—	—	—	—	—	1

*Those containing small fixed or removable bridges or partial dentures and those with several missing teeth.

From these data, it is apparent that the range from normal content to maximum content capacity is ½ fluid ounce to 3¾ fluid ounces and that there is a definite difference, a majority of the cases with natural dentures revealing a larger volume of fluid content.

In the absence of any definite knowledge as to form or type of teeth suitable for the case at hand, it is suggested that the use of the cephalic index according to the Duckworth modification be employed. The cephalic index is defined as the cranial index of breadth. As the cranium has the least amount of dimensional alteration, this index serves our purpose:

Index	Classification	Nomenclature
1. Cephalic	Below 75	Dolichocephalic
	Between 75 and 80	Mesaticephalic
	Above 80	Brachycephalic

The index is determined by dividing breadth by the anterior posterior cranial dimension. The percentage obtained determines the classification. Seventy-five per cent or less of the cases take the tapering form; 75 to 80 per cent are of the square type, and 80 per cent or over take the ovoid form.

Measurements for the purpose of determining the combined over-all contact dimensional ratio of crowns of the central incisors to the first molars reveal a mean of approximately 3:2 in a group of seventy-five cases selected at random.

The illuminating fact is the frequency of the 3:2 ratio. The collection of records of a sufficiently large number of subjects is proposed for scientific reasons. This information affords a working average constant that might well be incorporated in any plan for a rational approach to the problem of determining the vertical dimension.

Where maximum openings are contraindicated, it is suggested that the width of posterior pontics be reduced buccolingually to provide the necessary space for essential tongue function.

To discuss the vertical dimension without consideration of the selection of the plane of occlusion would mean an unfortunate omission.

The occlusal plane in full and natural denture rehabilitation has been widely discussed, yet its significance bears continued discussion. Just what is the plane of occlusion? It has frequently been confused with the curve of Spee. This anatomic landmark pertaining to the mandible begins with the mesio-incisal angle of the lower central incisor, continues over the crest of the buccal cusps of the bicuspids and molars and terminates at the anterior border of the condyloid process of the mandible. The plane is better described as a segment or concentric segment of a sphere chosen to establish the incisal and occlusal relationships of all teeth in position.

Much of the controversy as to the correct position of the plane of occlusion in full denture construction has

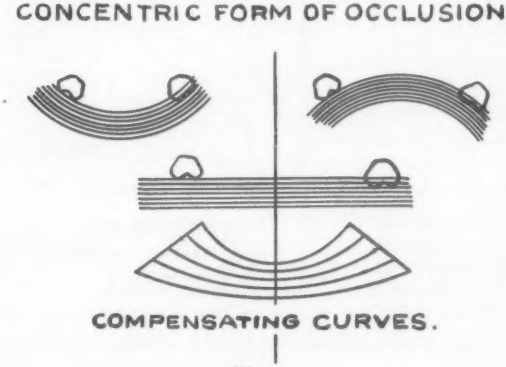

Fig. 1

been the result of a fundamental error in the conception of the plane. It has been observed that the occlusal surfaces in natural dentitions wear away continuously from the time of eruption. It is this range that I designate as the range of occlusal wear, the plane best suited for a case within this range being employed as the functional plane of occlusion. It is devastating to permit esthetics to be the sole determining factor in establishing the plane. It is frequently necessary and advisable to raise or lower the plane according to the prevailing conditions. Within limits, the occlusal plane should be lowered where a favorable maxillary condition exists and an unfavorable mandibular ridge is evident. Tests reveal that the dropping of the plane reduces the compensating curve, and the raising of the plane nearer to the temporomandibular joint increases the steepness of the curve. This is best illustrated by increasing or decreasing the radius of a circle and comparing segments of concentric arcs. These concentric arcs will prove illuminating. Once this subject is clearly understood, the problem of articulation will be less mystifying.

The selection of a plane parallel to an imaginary line, drawn from the tragus of the ear to the alae of the nose, is no longer tenable. This classic sequence has dimmed in significance from an observation that has given me no little satisfaction. A subject with a normal dental equipment having a fractured axis vertebra incased in a splint is limited in function even though the dentition and musculature are ideal. Obviously, therefore, this fact compels a revision of our conception of the dynamic ideal. The flexibility in positioning the buccal cavity to best effect the intake of food is accomplished by the axis vertebra, a pivotal arthrodial joint capable of orientating the head most favorably. It is illuminating to note that where the temperature of the liquid varies considerably, the axis positions the head differently to effect the intake. This is observed in the forward tilting of the head in drinking hot tea and the backward tilting of the head in drinking cold water. Further observation discloses the following fact. At the dinner table, the head is tipped forward in masticating and partaking of solid foods. A curious comparative observation of man, bird and beast in drinking water reveals this difference. Man drinking cold water from a glass tips his head back and depends on gravity to direct the water from the buccal cavity to the gullet. A bird uses his beak as a ladle and tips the head back in the same fashion and for the same purpose. A horse tips his

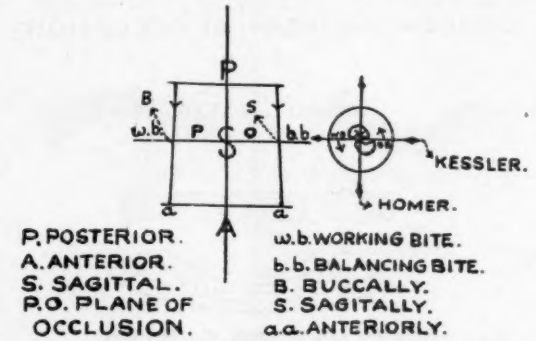

Fig. 2.—Balancing chart and guiding rules to contact tooth surfaces.

head forward and down to draw the water into the mouth. A partial vacuum thus created results in what is commonly called negative pressure or suction, which in turn results in intake of the liquid. Man apes this position when drinking beverages through a straw.

Before proceeding with the next phase of the paper, the following summary and conclusions are indicated:

1. The case history must precede every other approach.

2. The vertical dimension must be determined for each case after careful evaluation and correlation of all factors present, rather than the use of a one-shot formula, which may result in a percentage of successes and a greater number of failures.

3. The cubic content of the buccal cavity is a topic that demands further investigation.

4. The physiologic age of the patient is important in determining the actual tissue condition.

5. The morphology and the condition of the foundation should be known as far as is possible.

6. The symbols submitted illustrate the effects on the curvature of the plane of occlusion when it is raised or lowered. An understanding of this problem is thereby simplified.

7. An established occlusal relationship is not expected to continually serve a foundation that is in a state of flux. Therefore, regular periodic inspection is essential to adjust occlusal interrelationships when equilibrium is absent. When the foundation is altered sufficiently to disturb normal function, rebasing is necessary.

8. The over-all ratio of the anterior teeth to the posterior teeth should be utilized as a flexible working constant in a consideration of the vertical dimension.

9. The part played by the axis vertebra in orientating the head and the buccal cavity to facilitate the intake of solid and liquid food alters the conception of the factors in dynamic mastication.

10. Tongue crowding as a result of a closed dimension frequently causes tooth indentations on the margins of the tongue which are titled *lingua dentoformata.*

11. Esthetic values, an important factor, must be modified by other factors.

Where it is necessary to increase openings, it is suggested that this can be attained most favorably by increasing the dimension in stages to minimize discomfort to the patient.

POSITIONING TEETH IN DENTURE CONSTRUCTION

The second section of this paper deals with a method of positioning anatomic prosthetic posterior teeth. The subject of nonanatomic prosthetic posterior teeth will not be included in this presentation since the basic principles of occlusal interrelationships are adequately covered in the analysis of anatomic prosthetic posterior teeth. The indications for use and consideration of the variety of nonanatomic prosthetic teeth are of sufficient importance to be dealt with in a separate paper. In positioning anatomic prosthetic posterior teeth, the purpose is to secure such a dynamic occlusal relationship that the cusps, ridges and grooves of the opposing teeth are interdigitated, and the interrelationship is such that all points of contact are in harmony with the foundation and the voluntary and involuntary movements of the mandible and the temporomandibular joints effected by muscles and ligaments of mastication.

Walter H. Wright, of Pittsburgh, disclosing the results of three years' observation of several hundred full denture cases, reports that of 100 patients 85 per cent testified that they were able to masticate all kinds of food satisfactorily, even though 50 per cent of the

dentures were not in balance. This group observation suggests the following conclusions:

1. Cases may be in balance and yet fail, owing to a strained contact relationship effected by the resultant forces in centric position, when definitely not in equilibrium as indicated by a central-bearing check in completed full dentures.

2. Cases out of balance are usable and satisfactory if in equilibrium in centric position.

Resultant differential in muscular compressibility must be incorporated in a plan to solve the occlusal problem. A common error in the orthodox approach to this problem is the failure to appreciate the fact that cusps will not stop the anterior movement of the mandible. The more we comprehend existing altered conditions and pattern dentures with the maximum accommodation of the parts involved, the better will be the end-results. Obviously, if existing conditions can be improved by surgical procedures where indicated, these should be carried out.

The members that comprise the anatomic posterior teeth consist of four pairs of bicuspids and four pairs of molars. Each pair, for convenience, will hereafter be considered one unit. The total, therefore, is eight units, or sixteen prosthetic teeth. It is necessary to visualize each unit as one piece with the occlusal surfaces luted together for the simplification of the understanding of unit tooth movement.

So-called balancing relationships may be accomplished by:

1. A series of ascending planes, one from the cuspid to the mesiobuccal cusp of the first molar, one involving the first molar and one involving the second molar.

2. A concave Monson curve.

3. A convex Avery curve.

4. A combination of two or more of the foregoing.

The theoretical range of tooth position may be expressed by a circle with a perpendicular and a horizontal diameter bisecting each other. This symbol contains all the possible theoretical and practical positions that prosthetic tooth units may assume from a plane view. The upper half of the circle indicates the Avery curve; the lower concave half, the Monson curve. Bisecting these two is the plane.

It is suggested that where there is a marked unilateral difference in the intermaxillary opening, a series of trials should be conducted to determine the advisability of substituting for the plane of occlusion a concentric plane as symbolized. Within limits, this procedure has proved illuminating. Observing the occlusal plane of many adults, I find that this condition in natural dentures is more the rule than the exception. The interaction of geared wheels of different sizes, as in a clock, is an example of smoothness of function even though the components vary. Again the question may be raised: Why employ a symmetrical plane where variation exists in the glenoid fossa, in the heads of the condyles, in the ridge form and in the intermaxillary bilateral opening? Harmony can be attained without symmetry.

The determined position of each component must be correlated with these facts to be observed in every case:

1. Condylar guidance.

2. The form of the ridge, whether convex, concave, saddle-formed or knife-like, with the buccal sides of the mandibular and maxillary ridges sloping sagittally from mandible to maxilla.

3. Tissue tone.

The method of arriving at the desired position is based on the assumption that the trial dentures have been properly mounted on an adjustable instrument; the vertical dimension has been established for function and esthetic values; and the centric and eccentric relations have been recorded.

A point of caution is indicated here. Registering paths or positions over areas offering marked interference in trial dentures results in exaggerated curves that will inevitably mean failure. Such interfering components must be depressed.

Rule 1. All moving of teeth to bring them into balance should be done with the incisal guide pin in place to insure the retention of the centric relationship. A protruded position of the instrument should be registered so that the incisal edges of the maxillary and mandibular incisors of the trial dentures are in contact.

The incisal guide pin should touch the guide plane with the following teeth in contact: upper and lower central incisors, upper cuspids and first and second molars. The remaining teeth may or may not occlude, but they must not interfere in this protruded relationship.

Rule 2. If upper and lower central incisors are out of contact in this position, they should be given more overbite and less overjet as required. The same applies for the upper cuspids.

Rule 3. It may be established as a rule that the molars, when out of contact, can be brought into occlusion in protrusion by tipping the combined occlusal plane surface of the opposing molars mesially toward the mandible. If they interfere in protrusion, reversion is necessary. It should be here recorded that as the anteroposterior curve is increased, the necessity for spacing the teeth and grinding the cusps increases.

The next consideration is the lateral records of the case at hand. A balancing and a working side are noted. Since artificial dentures seldom attain the same degree of proficiency as natural dentures, it is advisable to secure as many contacting surfaces as possible in the working bite to increase the masticating area.

On the balancing side, in ideal cases, the upper and lower central incisors, one lower lateral incisor and the upper and lower molars should be in contact. The mesiolingual cusp of the upper first molar should pass through the distobuccal groove of the lower first molar. If the first molars move out of contact, the combined buccal occlusal surface plane of the opposing molars is tipped cranially. If they remain in contact, but the mesiolingual cusp of the upper first molar does not pass through the distobuccal groove of the lower first molar, the latter must be rotated, the tooth being turned with the groove toward the path of the cusp. The lingual cusp of the upper second molar should pass up the distobuccal side of the central fossa of the lower second molar. It is here that too heavy contact occurs, which frequently necessitates grinding. If there is no contact, the main rule prevails for the balancing side; i.e., the combined buccal occlusal surface plane of the opposing second molars is tilted cranially. The same procedure must be followed when the working side is shifted and becomes, in turn, the balancing side.

Attention is now centered on the working side. In favorable cases, we may succeed in establishing contact from the mesial aspect of the upper cuspid to the distal aspect of the lower second molar, both buccal and lingual cusps. The upper first bicuspid should articulate with both the lower bicuspids. The lower second bicuspid should articulate with both the upper bicuspids. The middle buccal cusp of the lower first molar should rest between the buccal cusps of the upper first molar and touch both. The mesiobuccal cusp of the upper first molar should rest in the buccal groove of the lower first molar and make contact with the mesiobuccal and middle buccal cusps of the lower first molar. The mesiobuccal cusp of the upper second molar should rest in the buccal groove of the lower second molar and make contact with both buccal cusps.

The distobuccal cusp of the lower second molar lies between the buccal cusps of the upper second molar and makes contact with both upper buccal cusps.

It will be noted that each buccal cusp mentioned makes contact with two opposing cusps. This is quite essential to prevent rotation of the denture bases and the resultant trauma.

The rule for bringing opposing posterior prosthetic teeth in contact in the working bite is to tilt the combined occlusal surface plane of the opposing posterior teeth in the buccal direction toward the mandible. This is equivalent to decreasing the lateral curve.

The trial dentures may now be tested and the incisal guide pin removed. Every tooth should then be checked to compensate for shrinkage of wax. It is essential that opposing occlusal surfaces glide smoothly over each other. Any interference should be milled away.

SUMMARY AND CONCLUSIONS

1. The popular conception of balance as an ideal prosthetic occlusal relationship is faulty, for balance may be strained and traumatic. The conception of equilibrium in dynamic occlusion implies a diffusion and distribution of the resultants of the masticatory forces on the occlusal surfaces in centric position so that no undue load-points are present as traumatic potentials.

2. A symbol is submitted to illustrate the theoretical and practical range of unit tooth movement.

3. The concentric concept of the plane of occlusion is of particular value where symmetry does not exist and, because of contra-indications, cannot be effected by surgical measures.

4. The laws governing contacts of occlusal relationship in anatomic prosthetic teeth by deliberate thrusts are formulated.

5. Recording differentials in resultant muscular compressibility on either masticating side should be an integral part of an adequate approach to the occlusal problem.

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128 Central Park South.

WHAT CONSIDERATION SHALL BE GIVEN TO PRENATAL CARE IN PREPARATION FOR GOOD TEETH?

By Percy R. Howe, D.D.S., Boston, Mass.

SUCH information as there is on the subject of prenatal care in its bearing on dental conditions is at best fragmentary. Even so, the question arises as to whether it is within the province of the dentist to make recommendations designed to bring about changes in fetal life. It probably is not. Rather is this a matter for the obstetrician. Nevertheless, the dentist may and should indicate to the medical practitioner that the teeth are calcifying and the bones which carry the teeth are undergoing ossification during fetal life, and that it is his duty to see that the normal processes of growth and development here go on uninterrupted. It is recognized that these processes are influenced more strongly by nutritional states than by any other factor.

Fetal growth and development proceed with marked regularity over a given period of time. We may, therefore, have some idea when specific food factors are in especial demand, as when calcification begins. It has been determined with considerable accuracy that the deciduous teeth begin to calcify about the seventeenth fetal week, and the maxillary bones and mandible begin their more permanent ossification at about the same time. However, the process of bone development has its actual beginning very early in fetal life. This is recognized as early as the seventh week. The two types of bone, the membranous and the cartilaginous, are essentially alike in their ultimate process of calcification. On the whole, food deficiencies are probably most apt to occur as the protoplasmic mass increases in size, or during the latter half of the period of pregnancy.

If we are right in thinking that calcification is an act on the part of the cell, either through the laying down of normal intercellular substances or directly, we know definite food factors which in a measure control this physiologic performance.

In experimental studies, food deficiencies during the reproductive state have resulted in abnormalities of various kinds, such as young being born with defective eyes or no eyes at all, peg-shaped teeth, double paws and other physical aberrations. There is not much precise information regarding the effect of specific deficiencies on tooth formation in fetal life, but it is reasonable to infer that in some measure the factors involved in growth and development after birth have to do with these processes before birth. I cannot understand how any observant practitioner can fail to appreciate the fact that some interference with fetal growth and development has occurred when we note the extent of mandibular and maxillary deformity. Dr. Toverud, of Norway, reports pathologic conditions in the teeth of new-born infants due to a prenatal lack of minerals and vitamins.[1]

Still another consideration in this con-

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nection is the effect on the fetus of disease in the mother. For example, it has been found that such a virus as that of influenza thrives in the fetus of guinea-pigs, while the mother remains refractory to it.[2] We have long felt that certain maternal diseases leave their imprints on the teeth, and here is evidence of the possibility of comparatively common disorders affecting normal development.

In a symposium on the diets best adapted to fulfil nutritional requirements of fetal development published in the *British Medical Journal*, it was agreed that an abundant diet was needed: that it should be recognized that metabolism is speeded up, and that the most common deficiencies were those of minerals and vitamins, the very substances which have been shown to be needed for sound teeth and bones after birth.[3] However, by this it is not meant that an indiscriminate endorsement of minerals and vitamins is advisable. Indeed, in obstetric publications, warnings have been sounded against this very thing. Clearly, advice regarding nutritional supplements should come from the obstetrician. It seems worth while to mention in this connection that it is always preferable to take natural foods rich in various factors rather than attempt to supply deficiencies by introducing single substances, since any deficiency rarely involves single factors alone.

Some evidence of the effect of favorable prenatal diets upon dentition is provided by a comprehensive research project in child growth and development now being conducted at the Harvard School of Public Health. The routine of this study includes independent appraisal of the diet throughout pregnancy and infancy. X-ray and dental examinations of the children are made at three-month intervals up to 18 months of age, and after that at six-month intervals. Indications are that children whose mothers' diets throughout pregnancy were rated poor in respect to calcium, phosphorus and vitamin D show considerable caries at an early age and have lower than average ratings for osseous development and density; that, at a comparable age, children whose mothers' diets during pregnancy were rated good or excellent tend to show no caries, and have average or above average ratings for osseous development and density.

There remains another consideration. This concerns such preparation of the mother as will enable her to give an ample supply of normal milk in order that the forming teeth in the infant's mouth may have every advantage. Again, lactation has been demonstrated to be largely a matter of the proper food and stability in the nervous state.

Thus, in the interest of good teeth and well-formed maxillae and mandibles, these recommendations are made:

First: That the dentist advise the obstetrician that calcification of teeth and bones is proceeding while the patient is under his supervision.

Second: That the dentist inform the mother as to the significance of the prenatal period to the dental health of her child.

Third: That the dentist familiarize himself with the general character of a diet in pregnancy which is favorable for normal calcification.

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WHAT PROCEDURES CAN BE INSTITUTED IN THE INFANT AND PRESCHOOL LIFE OF THE CHILD FOR THE PREVENTION AND CONTROL OF DENTAL CARIES?

By Russell W. Bunting, D.D.Sc., Ann Arbor, Mich.

DURING infancy and early childhood, the relationships of nutrition to bodily health are somewhat different from those of prenatal life. The fact that children are not born with rickets but develop it during the early years of postnatal life indicates that osseous and dental calcification is better safeguarded before than after birth. It is during these early years of childhood that the provision of adequate inorganic salts and those vitamins which seemingly activate inorganic salt metabolism is most significant.

The brilliant researches of Howe and others have shown the definite value of protective foods in the development of teeth and maxillary processes in animals. From this, it has been inferred that similar protective diets will have a salutary effect on bone and tooth development of children. Unfortunately, the human is a much more complex organism than the animal and apparently is not so readily protected from disturbances of calcification during the developmental period. Heredity and individual characteristics seem to play a more significant part in the determination of form and structure in the human being; that is, hypoplastic defects and malformations of the teeth and bones may occur in children who have been fed apparently good diets. It is well known that the present generation of children, in preferred families at least, have been reared on more adequate diets than previous generations and yet underdevelopment of the jaws and consequent malocclusion have not been noticeably decreased because of that fact. Outside of the mottled tooth areas, dental hypoplasia occurs as frequently today as formerly.

Unquestionably, during the developmental period, adequate building materials for tooth and bone formation should be provided, but it should be recognized that no dietary fortification will insure normal calcium metabolism. There are too many other factors, such as faults of digestion and assimilation, internal secretions, heredity, individual characteristics and exanthematous diseases which may interfere with or determine the process of tooth and bone formation. During infancy and early childhood, we should therefore recommend that, under the direction of the physician, children be fed adequate and highly fortified diets, but we should be cautious about assuring parents that such dietary programs will insure a normal dental and osseous development.

The development of strong, well-formed teeth is an important consideration in the growth of the child, but the occurrence

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of dental caries is quite another matter. By many, they are considered to be directly related, and it is frequently stated that dental caries may be prevented by building strong, highly resistant teeth. These views, however, are not in accord with facts. Every dental practitioner has observed hard, well-formed teeth that have been severely attacked by caries and soft, poorly formed teeth that have remained throughout life wholly unaffected by the disease. It is true that soft teeth may be more rapidly and extensively involved by caries than hard teeth, but there is no evidence that the occurrence of the disease is directly related to or determined by the degree of dental calcification. No tooth was ever so hard that it could not decay. No tooth ever decayed solely because it was soft or poorly formed. It is highly improbable, therefore, that the prevention of dental caries and the protection of the child from this disease can be attained by the building of better teeth or by the feeding of highly fortified diets, desirable though they may be from other standpoints.

The dental disease which affects so large a proportion of children is unquestionably a bacterial process. In the great majority, the mouth is infested with types of organisms capable of producing acids of sufficient strength to decalcify the tooth and cause typical lesions of caries. Among these, *L. acidophilus* is most prominently associated with the disease. It is not fully proved nor generally agreed that this organism is the sole or specific cause of dental caries, but it is well known today that the activity of its growth in the mouth is directly proportional to the degree of activity of the disease. When there is no caries in teeth, there is usually no acidophilus in the mouth. When caries is active, the organism is always present in varying degrees of activity. Although this correlation is not 100 per cent positive, it is approximately 90 per cent constant. So definite is this bacteriologic relationship that the acidophilus counts of salivary samples may be taken as a true index of dental caries activity at any given time. If the acidophilus counts remain high, the teeth will decay with varying degrees of rapidity, depending on the number of acidophilus organisms continually present in the mouth and the relative hardness of the teeth. If the counts remain consistently low or zero, there will be little or no caries irrespective of the quality of the teeth.

If this is true, the logical approach to the problem of preventing dental caries in childhood is the reduction of the growth of *L. acidophilus* in the mouth. Three avenues of approach are suggested; namely, immunology; hygiene and therapeutics, and diet. As time does not permit a discussion of each of these considerations, my remarks will be confined to the part that diet may play in the process.

Many conflicting viewpoints have been expressed relative to diet as a causative factor in dental caries. Many of the opinions expressed are confusing and erroneous. The majority of theories of dietary control of caries are based on the principle of fortifying the diet to strengthen the teeth and to make them more resistant to the disease. This assumes that hard teeth will not decay, which is not true. At the present time, the most popular dietary program consists of feeding an adequate ration, to which substantial doses of calcium, phosphorus and vitamin D are added. May Mellanby, McBeath and other report that by the feeding of such a dietary, the total amount of caries is reduced. They do not claim a total arrest of the disease.

The Michigan Dental Caries research group have fed dicalcium phosphate and viosterol to caries-susceptible individuals and have found that, in the majority of cases, the acidophilus counts are increased rather than decreased, and they have not observed any appreciable reduction of

caries. It is possible that larger doses of vitamin D may have some inhibitive effect on salivary acidophilus, but at the present time we have no evidence to support that assumption.

The Michigan group, however, has found that by the reduction in the diet of sugar alone, in some cases, and of sugar and starch in others, depending on the degree of caries susceptibility, the salivary acidophilus may be reduced to very low counts, or zero, and in these cases dental caries is completely arrested. Large groups of children in orphanages were observed over a period of several years, during which they were fed extremely low sugar diets which were not otherwise fortified. Although the majority of these children originally had more or less caries, during their residence in the institution many of them developed no new cavities and previously unfilled cavities grew no larger. Certainly, the evident arrest of caries in these children could not be attributed to the excellence of their diet. The low sugar intake was the only discernible factor which could be related to the control of the disease.

Many dentists are now controlling caries in children by the simple expedient of withholding sugar from their diets. In some highly susceptible cases, however, this alone will not stop the disease. For them, it is necessary to reduce the starch intake as well. The efficacy of these measures can be determined by making salivary acidophilus determinations to see whether the counts are definitely reduced to insignificant numbers. These counts are now being made by the University of Michigan laboratories of saliva sent in by dentists by air mail, some from great distances from Ann Arbor. In this manner, the dentist is guided in his advice to the patient and may determine when the dental disease is under control. It is strongly recommended that all such dietary manipulations for children be made only through the direct cooperation of the family physician.

It is recognized that this is not the final answer to the problem of caries control, but it is an answer. Formerly, we had none. It is not possible to induce all children to forego candy and sweets. They would choose rather to allow their teeth to decay. The habits of sugar consumption are deeply entrenched in the American people. From earliest infancy, sugar is incorporated in the diet, and it is later provided in the form of candy and highly sweetened foods. The pediatricians and the grandparents are most responsible for candy hunger in children. It is said that children need sugar for quick energy and that in early infancy it prevents acidosis. Thus, in the tender months and years, a craving for sweets is established which in later life it requires 125 pounds per year to satisfy. One hundred years ago, sugar consumption was 12 pounds per year per capita. That generation survived very well without the present-day benefits of the sugar industry and furnished the pioneers that cleared the land and founded the cities in which we live. Today, we are told that our infants must have glucose and highly sweetened milk formulae or there will be dire results. If by the daily feeding to infants of a substance so disagreeable in taste as cod liver oil, a taste may be acquired that will cause them to lick the spoon, how much easier may a craving for sweets be established in the early years.

We have observed many children who have not been fed high sugar diets either during infancy or in early childhood. These children play with candies as if they were marbles but have no desire to eat them. Children so reared have little or no dental caries and appear to be immune to the disease. If, during their school days, they acquire the taste for sweets and eat freely of them, dental caries often becomes active. Evidence is rapidly mounting that the avaricious and unnatural craving for sweets which is acquired during infant days and pre-

vails most acutely during childhood is largely responsible for the high incidence of dental caries during that period of life.

It is our opinion, therefore, that for the sake of the dental health of the child, an adequate, well-fortified diet should be provided during infancy to assist in the building of good teeth and good bones; for the prevention of dental caries, the intake of sugar in all forms should be avoided, and, if possible, the child should be kept from acquiring an inordinate desire for sweets. Control the sugar habits of the child and you will most effectively protect him from dental caries.

Dental caries is not a deficiency disease: it is a luxury disease.

916 Church Street.

WHAT PROCEDURES SHOULD BE FOLLOWED FOR EARLY DETECTION AND CORRECTION OF DEFECTS IN DECIDUOUS AND PERMANENT TEETH?

By George E. Morgan, D.D.S., Milwaukee, Wis.

BEFORE considering the procedures involved in the early detection and correction of defects in the deciduous and permanent teeth, it is necessary for us, first of all, to have some understanding of what constitutes a dental defect. Too often dental caries is placed in the category of a dental defect. While in reality a defect may be a predisposing cause of dental caries, it definitely portrays a lack of something necessary for completeness. Therefore, a dental defect is any deficiency which interferes with completeness owing largely to some phenomenal disturbance during the period of growth and development. When the term "dental defect" is applied to the deciduous and permanent teeth, we have defects of form, defects of resorption, defects of eruption, defects of number and defects of occlusion. All these are defects of development and can be diagnosed usually during their inception or shortly after and be prevented or corrected.

The early detection of dental defects, which is the science of prevention, calls for great skill in diagnosis, because it is not the result of environmental influences, but usually springs from the mysterious depths of the unknown. However, if we can establish the practice of routine full-mouth roentgenographic examinations early in the life of the child and early in the life of the individual tooth and acquire the habit of employing a systematized method for the clinical examination, together with sharp explorers, a clean dry field and good light, in dentistry for children, we can, in most instances, detect and correct the more common dental defects before any serious dental impairment has taken place.

Dental defects of a more perplexing nature present a different problem. If

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we, as dentists, could learn to appreciate the need for consultation with fellow practitioners as our colleagues in the medical profession are doing when confronted with the unusual, and, many times, with what appears to be the usual, we could not only prevent, but also easily correct the most disturbing conditions. For example: A child 3 years of age, a clinic patient, with a physical record of underweight, lowered resistance, loss of appetite and poor sleeping habits, was being treated. Clinically, the mouth showed lack of home care with marked gingivitis, the anterior deciduous teeth were badly decayed and the upper left deciduous central incisor appeared darker. Upon roentgenographic examination, the permanent central incisors showed a defect of form in the development of the middle lobe. This condition was unusual and presented a problem in diagnosis. Syphilis was suspected. Upon consultation with other members of the dental profession and the physician, it was decided to suggest a Wassermann test. The child had a four plus reaction and the defect of form of the upper permanent central incisors was diagnosed as Hutchinson's teeth long before their eruption. (Fig. 1.)

Fig. 1.—Typical hutchinsonian permanent central incisors, in child aged 3; showing defect of form in development of middle lobe. (Courtesy of T. R. Abbott.)

Fig. 2.—Marked occlusal fissures in lower left first permanent molar extending into dentin, in child aged 8.

While this defect could not be corrected, the discovery of the syphilitic con-

Fig. 3.—Prolonged retention of upper left deciduous central and lateral incisors and rotation of permanent central incisor, in child aged 8. (Abbott.)

Fig. 4.—Prolonged retention of lower left second deciduous molar due to defect of resorption, in child aged 13.

dition could definitely be traced to the detection of a dental defect and, upon medical and dental treatment, the child's general resistance could be greatly increased.

Another type of defect of form that has aroused much discussion with regard to its early detection and correction in dentistry for children is the pit or fissure in the permanent teeth. Very often, mouths that are practically immune to caries show a number of what clinically appears to be superficial fissures in the first permanent molars, but, upon roentgenographic study, these fissures are shown to extend well into the dentin. (Fig. 2.) At the same time, these defects

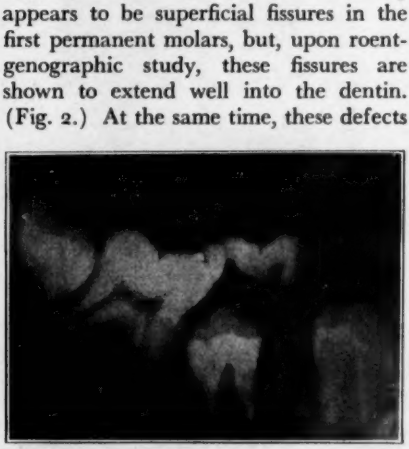


Fig. 5.—Defect of eruption, showing lower left first permanent molar impacted against second deciduous molar, in child aged 8.

of form are commonly found in the cingulum of the upper anterior permanent teeth.

The questions asked in the correction of these pit and fissure defects are "Will the application of silver nitrate preserve the tooth?" or "Do you think these teeth should be protected by a cement wash soon after their eruption?" or "Do you believe the tooth should be filled?" The preservation of tooth structure, if we are really concerned with true prevention, is no different from the preservation of stone structures or buildings. The correction of these defects is none other than the operative removal of the fissure and permanent restoration of the tooth to form and function. The early detection and correction of all defects of form will largely prevent the early loss of teeth through dental caries.

More permanent teeth have become malpositioned owing to defects in the resorptive processes of the deciduous teeth and, as a result, these teeth rotate during the impulse of eruption to find

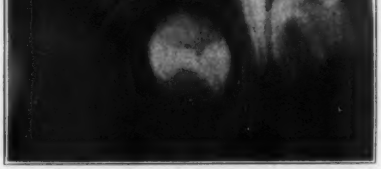


Fig. 6.—Premature eruption of lower right first bicuspid due to early loss of first deciduous molar, in child aged 6.

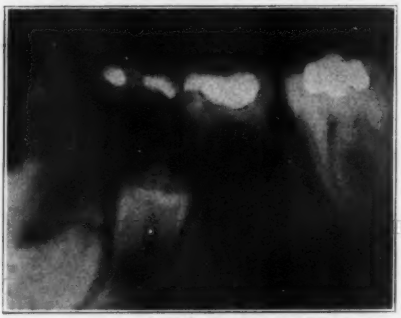


Fig. 7.—Defect of number, showing congenital absence of lower right second bicuspid with abscessed condition of deciduous molar, in child aged 7.

the path of least resistance. The diagnosis of these defects of resorption must of necessity involve judicious skill, as it is as harmful to resort to wholesale extraction as it is to permit prolonged retention. On the other hand, it is easier to prevent the malposition and rotation

of the individual tooth than it is to correct it. Therefore, our only guide to the detection of defects of resorption besides the age of the child in comparison to the law of average exfoliation and eruption is the roentgen-rays.

In the anterior region of the mouth, the more common defects of resorption are found in the lower jaw, while the least suspected defects are in the upper anterior teeth. The rotation of the upper permanent central incisor always presents a serious problem to both the parent and the dentist and very often is not diagnosed until the tooth or its neighbor has erupted. (Fig. 3.)

The phenomena involved in the submerging of the deciduous teeth are better understood when we realize that these teeth have failed to grow occlusally and eventually acquire a senescent appearance. Invariably, the defect in the process of resorption of the submerging deciduous tooth will result in prolonged retention and, unless the condition is diagnosed early, will cause the permanent successor to rotate in its effort to erupt. (Fig. 4.)

Routine roentgenographic supervision of every child during the transitional period is the greatest aid in the early detection and correction of defects of resorption.

The most puzzling defects of eruption in pedodontia are those affecting the permanent teeth. In young mouths, the first permanent molars very often become fixed in such a position that they are impacted against the bell-shaped crowns of the second deciduous molars. (Fig. 5.) The impaction prevents complete eruption and unless discovered early will result in the premature loss of the second deciduous molar. This type of defect of eruption can be found in both arches. Prevention of such a condition is simply this—early diagnosis of the defect and placing a band around the second deciduous molar to guide the first permanent molar into its upright position; provided, however, the *vis a tergo,* or impulse, of eruption is still present, and the early loss of the deciduous molar through infection is prevented.

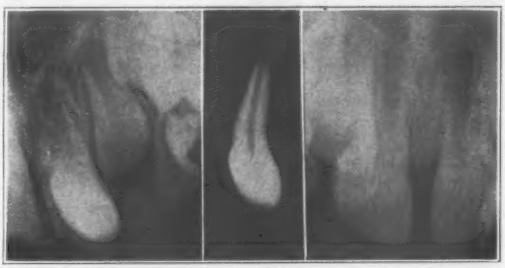


Fig. 8.—Left: Supernumerary tooth positioned within outline of upper right central incisor. Center: Extracted supernumerary tooth. Right: Area after extraction.

Premature eruption of teeth (Fig. 6) is also generally due to the premature loss of the deciduous predecessor, where a great deal of the bony process has been destroyed through infection. Unfortunately, the child who is the victim of such loss is one who receives little or no dental health service. The prematurely erupted tooth is like a prematurely born infant—it must be carefully protected from outside forces. It is well, in such cases, to instruct the patient to masticate on the other side, to be careful in brushing the tooth and to increase circulation

in that area by careful massage of the gums until the tooth shows more root development.

A great many children are victims of defects of number, especially in the permanent teeth. These defects may either be a super or an infra number. However, the infranumerary condition is the most common. For example, we see many children who have received dental service of an inferior type and who eventually change dentists because of diseased mouths and impaired health. Roentgenographic examination shows that the carelessly filled deciduous teeth are badly abscessed and the second deciduous molar is without a permanent successor. (Fig. 7.) From the standpoint of health,

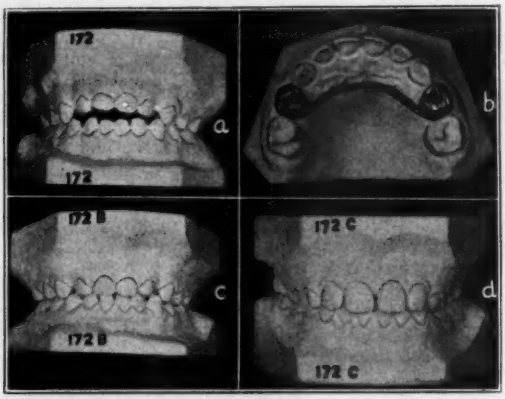


Fig. 9.—*a*, Defect of occlusion due to thumb-sucking, in child aged 4. *b*, Type of pedodontic appliance used to stop habit; worn for two months. *c*, Natural correction of malocclusion of deciduous teeth two months after removal of appliance. *d*, Case at 8 years of age, showing normal occlusion in permanent dentition.

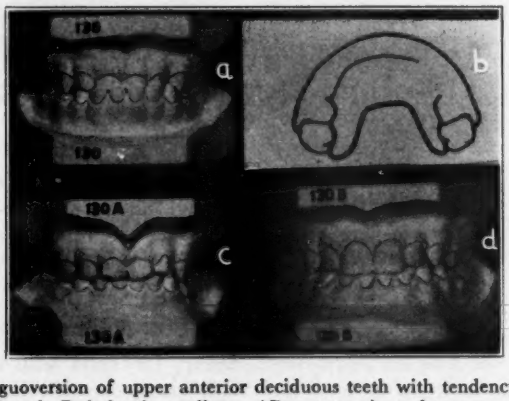


Fig. 10.—*a*, Linguoversion of upper anterior deciduous teeth with tendency toward mesioclusion, in child aged 4. *b*, Pedodontic appliance (Crozat type) used to correct defect. *c*, Model of case after correction of defect of occlusion. *d*, Case at 11 years with no treatment of permanent dentition.

the diseased teeth must be extracted. One then has to decide whether to let the first permanent molar drift mesially and fill the space that is normally occupied by the second bicuspid or to retain the space for an artificial restoration when the child is older. These are problems of serious consequences. The type of dental health service received by this child certainly portrays shortsightedness and a lack of knowledge in the science of prevention. The early use of the roentgen-rays would have revealed the defect, and through proper treatment, the deciduous tooth might have been retained for many years or possibly for the lifetime of the patient. We must do away with the practice of blindfold dentistry for children, if we are to give adequate dental care to all the children in our everyday practice.

Early discovery and extraction of the supernumerary tooth will usually permit the normal tooth to erupt in its correct position. These defects of number usually involve the upper anterior region near the median line and may be within the outline of the permanent central incisor. (Fig. 8). To determine whether the extra tooth is mesial or distal or is fused with the permanent central incisor is often difficult and may require roentgenograms taken at different angles.

There are two defects of occlusion of the deciduous teeth which must be detected and corrected early in order to prevent extreme malocclusion of the permanent teeth. The first and most common is the defect in occlusion caused by the pernicious habit of thumb-sucking. (Fig. 9, *a.)* The treatment is simple and inexpensive if carried out before the child is 4 years of age. When the ordinary methods of home treatment have failed, a pedodontic appliance attached by means of overlays on the first deciduous molars with a slightly raised palatal bar to destroy the sucking sensation will stop the habit, even in the most stubborn cases, within a few months. (Fig. 9, *b.)* The malocclusion caused by the thumb-sucking invariably corrects itself after the habit is checked. (Fig. 9, *c.)* When the malocclusion is corrected before the exfoliation of the anterior deciduous teeth, the permanent teeth erupt and assume their normal positions in the arches. (Fig. 9, *d.)*

The other defect of occlusion of the deciduous teeth which influences the permanent dentition is linguoversion of the upper anterior deciduous teeth with a tendency toward mesioclusion. (Fig. 10, *a.)* When these cases are diagnosed in the deciduous denture, the malocclusion can be corrected by a simple pedodontic appliance. (Fig. 10, *b.)* After the teeth have been moved into the normal position (Fig. 10, *c.)*, the natural forces of occlusion will retain them. The correction of this defect before 5 years of age will allow normal jaw growth and development in the upper arch and thereby stimulate both arches to symmetrical development and give the permanent teeth a chance to erupt in normal alinement. (Fig. 10, *d)*. Most cases of extreme mesioclusion can be prevented in the permanent dentition if the defect is diagnosed in the deciduous denture and corrected before the fifth year of life.

Dental defects are not uncommon in the mouths of children and their early detection and correction are the responsibility of every dentist. Regular dental health service for children, beginning at the age of 3, can do more to prevent serious dental impairment than any other procedure.

2039 North Prospect Avenue.

MANAGEMENT OF CHILDREN IN THE DENTAL OFFICE

By JOHN E. GURLEY, D.D.S., San Francisco, Calif.

WHEN I was about 6 years old, my father, a tall, lanky dark-haired man, who though not deaf, was hard of hearing and who had a will to do what had to be done and a determination which carried it through to completion, one day took me to the dentist because of an aching tooth. This meant, in those days, a return home with one tooth less.

The memory of this is not a pleasant one and it is a safe deduction that the young patient demonstrated his proficiency in the use of profanity. With a deaf sire, there was little to fear as he trudged away from the venerable dentist's office, holding his chin in one hand and with the other hand in that of his parent.

When the professional horizon opened before me, and I became conscious of the fact that I was in that profession for life, a dentist, a professional man, my mind inadvertently ran back through the years to the occasion just described, and I determined that no child should ever leave my office in such mental and physical condition. This, perhaps, has not been possible of accomplishment, but as far as is humanly possible, an effort has been made.

It is not possible, of course, for any man to tell another how to do a thing. He may be quite successful, in certain cases of a concrete or specific nature, in telling or showing how he, himself, does it, but the other man must develop his own technic. In those more abstract cases, in which the management of children is concerned, the difficulty is increased.

Many operators are dependent on, and apparently successful in, the use of special children's equipment, such as dollhouse cabinets, small chairs, walls decorated like a kindergarten or infants' class in a Sunday school, and other paraphernalia which go to make up a child's world. But it has been my observation that children care for these things only at home or when their play may proceed through an unbroken period. Further, a husky boy of 10 years is embarrassed and even disgusted in an atmosphere prepared for a little girl of 2 years. Similarly, should a child of 5 years become interested in something found in the dental office, we initiate a disruption by taking him or her from it. We have also planted the suggestion of trickery or deceit. One should think and plan for consistent advancement. All these accessories are excellent in the home, for here the child plays hour after hour and, through it all, he learns. They are necessary in the school or the Sunday school, for understanding is thus developed.

But, even in these instances, there is

Presented in a symposium on "Dental Health for American Youth" at the Third General Meeting of the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 27, 1938.

one fact that we have overlooked, the personal relationship of the mother or the teacher, which is of prime importance, for with both of these the child has a long and close acquaintance and association. His visits to the dentist, though comparatively few and of short duration, have a similar personal aspect. The dentist then must devise methods of attracting and holding the child's attention.

As recently pointed out by Dr. Lamons,[1] in the management of children in a dental practice, "three people are involved: the dentist, the child and the parent or parents."

The child holds the center of the stage, but the dentist is the principal actor. On his actions depends his success or failure. To condense my observations to a few stated principles that have been made law in my own office:

1. The dentist must find his place between the parent and the child.

2. No one, other than the dentist, should address the child patient without permission to do so.

3. The dentist should never deceive a child.

4. The child patient should be told what we are going to do, and why and how, as nearly as possible.

5. The dentist should not attempt to bring the child to his level of thinking or acting nor go to his, but rather should find a common level for himself and his patient. If we go to his, we become foolish in his eyes; and he cannot come to us; so how is the desired status to be established? The patient's age will indicate his school grade; and we can recall something in our own knowledge of that grade and talk it over with him. He will be surprised and pleased at our intelligence and he will enjoy the discussion.

I recall the case of a girl with whom I had great difficulty. She dreaded to see me and, I confess, I almost dreaded to see her. One morning as she came in with characteristic reluctance, I asked her if she had ever read "The Old Oaken Bucket." In as unresponsive manner as possible, she replied, "No." I referred to the old school book in which I had first read it and the mother said, "I have it." On my request, she agreed to lend it to me and was to bring it next time. At the next appointment, the patient came beaming into the office and exclaimed, "Oh, Dr. Gurley, what do you think? I went to the show the other day and the first thing shown on the screen was a picture illustrating the 'Old Oaken Bucket.'" We had no more trouble, and her visits became a pleasure to both of us.

Another instance: A little girl said, "Dr. Gurley, I like you." To my query, "Why?" she replied, "Well, you are just like my father; you make me do what you want and I like it."

These things can be done by finding a common level on which to meet, thus bringing two understanding minds together—one a child and the other an adult.

6. While there are three persons to be considered, chief consideration should be given by the dentist to the dentist himself. This might be summed up and stated in one word, personality. May I then offer the following as those factors in personality through which children should be easily managed:

(a) Appearance; cleanliness, both personally and in the office.

(b) Attitude; a facial expression of interest and pleasure.

(c) Courteousness. If courtesy is a fine art between adults, it is a finer art in dealing with children.

(d) Naturalness. As the children say, "Be yourself." The dentist must show no

1. Lamons, F. F.: Psychology and Children's Dental Practice. J.A.D.A., 25:553, April 1938.

affectations. The child is truly natural, so must he be.

(e) Sincerity. This is the basis of psychologic reactions and is of great significance in dealing with children.

(f) Ability. The dentist must know what he can do. This is self-confidence, without which no one, not even a child, will trust one. To enlarge upon this a little: Use sharp instruments, carefully and skilfully; make no slips; follow a definitely planned procedure both in all the work and in each step separately; plan well the cavity preparation.

(g) Character. A little child is only good; he sees good; he knows protection which is prompted by love. Therefore, one should love children, and this love of children is, in its final analysis, good character.

Back of it all is our conception of our profession. If it is merely a means of making money, we had better not begin. But if we have a vision of dentistry as a health service and see what can be accomplished through its practice for children, including the making of a living for us, it is an open sesame to a fine and constructive professional life.

Our work is somewhat in the nature of teaching; consequently, traits of personality do enter into the picture. They inspire confidence, admiration and respect. These we must have in handling our child patients.

350 Post Street.

WHAT IS THE RÔLE OF DECIDUOUS BUCCAL FUNCTION IN PREVENTIVE ORTHODONTICS?

By R. C. Willett, D.M.D., F.A.C.D., Peoria, Ill.

THE time is limited for a comprehensive discussion of any one of the many intermingling problems of children's dentistry and orthodontics. Nevertheless, I shall endeavor to briefly call atttention to certain fundamental principles of denture growth dependent upon buccal function of the deciduous teeth.

In the case of a child of normal vigor and health, it may be observed by the dentist who will take time to make record casts of a few selected cases at regular intervals of six months, from about the time eight deciduous teeth have erupted, that immediately after the eruption of twenty deciduous teeth, the first and second molars stand apart and are not in proximal contact.

Up to that time in a child's life, dental progress has been dominated principally by the intrinsic factors of growth inherent in the formation of the organism. The next change to be observed in the child's mouth is the closing of spaces between the deciduous molars. This occurs as a result of the development of the first permanent molars and the adaptation of deciduous molar function, the principal extrinsic factor in growth and development.

Presented in a symposium on "Dental Health for American Youth" at the Third General Meeting of the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 27, 1938.

Provided the mesiodistal diameters of the deciduous teeth have not been impaired by neglected caries or traumatic injuries (with special reference to the molars and cuspids) and the teeth are retained for the normal period, the denture moves forward *en masse* until ample space for the first permanent molars has been developed.

Because Nature has chosen this method of space extension, it is inevitable that prior to and at this particular period of denture development, the slightest alteration of proximal contact between a first and a second deciduous molar, or between the first deciduous molar and the deciduous cuspid, is capable of disturbing the forward growth of the entire denture. Biologic reasoning should make it clear that through any such interference with natural processes of denture growth at this particular period of life, the developing permanent teeth can be deflected or detained from assuming their normal positions, and that any operation involving the buccal proximal contact is a matter demanding of the operator the utmost care.

It has been my observation, from an orthodontic point of view, that, owing to the anatomic form of the deciduous molars and their size, quality and distribution of enamel, regardless of how securely a matrix may be adapted or what method of operative technic may be employed in the preparation of the cavity, plastic filling materials do not fulfil the requirements for proximal surface restorations. The slice cavity preparation for the making of indirect proximal inlays or overlay restorations, if properly carried through, overcomes the discouraging features of plastic materials in dealing with deciduous molar and cuspid proximal defects.

When making preparation for proximal restorations in deciduous molars in the young child, the operator should plan to complete the service the same day that it is started if the child patient is to receive the full benefit from the procedure, because, under the influence of the developing first permanent molars, the second deciduous molars are carried forward rapidly when any degree of contact between a first and a second deciduous molar is broken.

Proximal caries of the deciduous incisors that so frequently occurs as early as two years before the eruption of the first permanent molars is reflected in the buccal width of the dental arches in this way. The incisors become painful to bite upon and the tendency then is for the child to bolt his food without exercising buccal function. Cavity preparation of sufficient depth to retain filling material in deciduous incisors endangers the pulp. For that reason, rather than attempting to fill them, I advocate cutting away carious proximal surfaces to the extent that there will be no deep recesses that might catch and retain decomposing foodstuffs. Ammoniated silver nitrate is then applied to the proximal surfaces in the same way that J. M. Prime advocates its application for the immunizing of occlusal and proximal surfaces.

The question may be justly raised, "How is trimming down the proximal surfaces going to affect occlusion and incisor function?" Such a method, effectively carried out in the treatment of deciduous incisors, has been observed to have no ill effect upon dental arch growth and future occlusion, provided deciduous molar function was unimpaired and dental arch relationship was normal. If the spaces left between the teeth are self-cleansing and the silver nitrate treatment has been thorough, the child experiences no difficulty in biting and tearing fibrous and hard foods. In fact, such foodstuffs as celery, carrots and apples wedge between the teeth and increase the tendency to interdental spacing of the deciduous incisors, reflecting benefit to growth of the entire denture.

The damaging effect of impaired buccal function resulting from the premature loss of one or more of the deciduous molars presents a problem that as yet has not been accorded a competent and thorough investigation. The situation accounts for the many diversified opinions that have been expressed concerning the ultimate effect upon adult occlusion which the premature loss of deciduous molars may have.

The investigation and study that I have made of hundreds of case records have shown that the effect of the premature loss of a certain deciduous molar or even of several of them differs widely in the cases of children of the same age or state of dentition.

A few exceptional cases are usually found in a large group of mouth examinations; and the reexamination of these exceptional cases demonstrates the outstanding persistency of certain intrinsic factors which make for normal growth and development in spite of serious obstacles. Despite these rare and exceptional instances of normal dentition following the premature loss of one or more deciduous molars, such a loss is by no means a matter of small importance or one calling for less than the best professional skill and judgment. The fact remains that bone growth and muscular force cannot be so evenly developed, and in so symmetrical a form, as in the case of the child who sustains no such losses, even though there is no apparent physical imperfection to the casual observer in the appearance of the tissues involved.

The ultimate effect of premature loss of one or more deciduous molars depends entirely on the physical condition of the dental organism as a whole at the time this loss occurs, the number of the deciduous molars involved, the normality or abnormality of internal and external muscular forces and the question whether the loss is in the mandibular or in the maxillary arch.

I shall now speak concerning the premature loss of a first deciduous molar, because the early loss of this particular tooth is frequently lightly considered, for the reason, I presume, that occasionally there is immediate eruption of the first bicuspid, even as early as between the sixth and seventh years.

Should the loss of a first deciduous molar occur on one side of the maxillary arch prior to the onset of active development of the first permanent molar and while it is deeply embedded in its crypt, through lip pressure alone the anterior teeth may drift distally and close the space. This action of the lip also inhibits width growth in the cuspid area. Should the loss occur during active development of the first permanent molar, the second deciduous molar is carried forward and encroaches upon the first deciduous molar space. The space may close as a result of both the wedging force of the developing first permanent molar and the posterior drift of the anterior teeth. In any event, the normal forward growth of the denture is arrested, and some degree of malocclusion is inevitable.

Should a bilateral loss of the mandibular first deciduous molars occur prior to or at the onset of the eruption of the first permanent molars, the occlusion of the anterior teeth and the relationship of the dental arches may be affected in two ways:

1. Should the upper lip be lacking in normal tension and be inclined to elevate, its action will eventually cause the maxillary incisors to protrude. At the same time, the force of the lower lip carries the mandibular incisors lingually and may even be reflected in the relationship of the dental arches.

2. A reverse type of malocclusion may occur when the muscular tension of the upper lip on the maxillary incisors is normal and the lip is not inclined to be elevated. Under the influence of such an external force, the premature loss

of the mandibular first deciduous molars frequently results in an anterior collapse of both dental arches. The overbite of the maxillary incisors becomes more pronounced, and when the permanent ones erupt, they are malalined and overlap.

The premature loss of second deciduous molars has less noticeable effect upon the alinement of the anterior teeth than premature loss of the first deciduous molars. The damaging effect here is in the occlusal relationship of the permanent molars and the possibility of either an impaction or a lingual maleruption of the second bicuspids.

In the cases of children of robust physique, with a normal relationship of the dental arches, and having a normal respiration, the loss of one or even two maxillary deciduous incisors at the age of 2½ years does not necessarily have a marked effect upon dental arch formation and growth if buccal function of the deciduous molars and cuspids remains unimpaired.

The maintenance of function of the deciduous molars, cuspids and first permanent molars seems to be of greatest importance in promoting normal arch growth. Except in very special cases, such as that of a child who exhibits difficulty in speaking and is in danger of acquiring an undesirable speech habit, or who takes part in professional theatrical productions and therefore must appear without a physical blemish, there is no justifiable reason for attempting the artificial replacement of prematurely lost maxillary deciduous incisors. The same cannot be said regarding the premature loss of one or more mandibular deciduous incisors, but even here the child of robust physique, with a normal dental arch relationship and having unimpaired deciduous molars and cuspids, may suffer no serious dental disability. Should there be a variation from normal dental arch relationship or an inherent or acquired physical deficiency, a mechanical support, if properly designed, may be indicated and may serve to intercept malocclusion.

In closing, I must emphasize the fact that any phase of juvenile restorative dentistry from simple to complex restorations involving buccal function involves a growth problem.

Carefully prepared record casts, inscribed with case number, name, date and age to designate the order in which they are made, are invaluable in observing the trend of dentition and the comparative results of the technic employed.

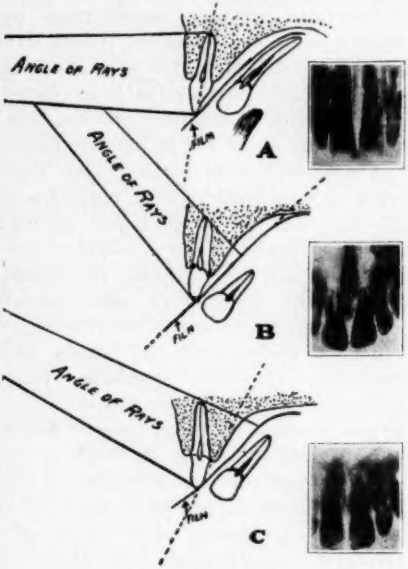
I wish to further impress upon those working with children that, regardless of all that can be demonstrated through what we choose to term "adequate prophylaxis" and the satisfying results possible in the majority of cases, parents must not be led to believe that the occurrence of malocclusion is entirely preventable. Generally speaking, many anomalies of dentition are obscure. Their origin is sealed in the mystery of heredity, the morbid factors of which in one way or another are reflected in the growth and development of the body as a whole, frequently with more pronounced manifestations in the oral ensemble.

Jefferson Building.

A SIMPLE WAY TO PRODUCE CONSISTENTLY ACCURATE INTRAORAL ROENTGENOGRAMS AND A MODIFICATION OF THE TECHNIC OF DENTAL ROENTGENOGRAPHY*

By THEODORE KALETSKY, D.D.S., New York City

FOR many years, dental literature has taught us that to make an accurate roentgenogram, we must direct the central x-ray beam at right angles to the plane that bisects the angle formed by the long axis of the tooth and the film. (Fig. 1.) The principle of this theory is unquestionably geometrically correct, but, like so many other theories, it does not seem to work out well in practice. If it did, it would be difficult to account for the many films that are of doubtful diagnostic value, and some of no value at all. Dental roentgenography is taught extensively in schools and in excellent postgraduate courses, and still the majority of practitioners are not able to produce good films routinely. Obviously, there must be some reason for these technical difficulties, which so frequently



-Correct and incorrect technic.

Fig. 1.—Diagram showing accepted technic of dental roentgenography. (From McCoy's "Dental and Oral Radiography," 1916.)

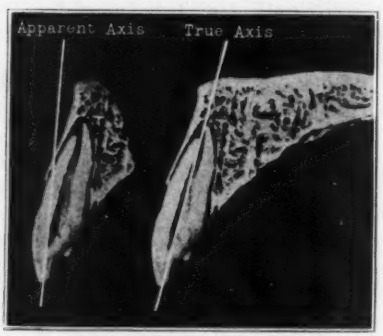


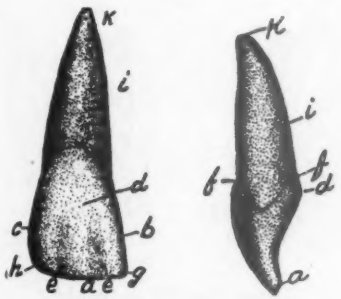
Fig. 2.—Apparent axis and true axis shown on same tooth. Because only the crown of the tooth is visible, the apparent axis of the tooth is determined by drawing a line through the vertical axis of the crown. If the images were superimposed, these two lines would converge at the tip of the crown and form an angle, called the crown-root angle.

Read at the Twentieth Annual Meeting of the American Society of Oral Surgeons and Exodontists, St. Louis, Mo., October 21, 1938.

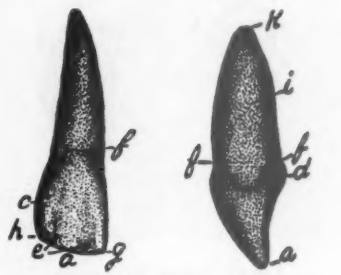
*A report from the New York Institute of Clinical Pathology; aided by a grant from the American Society of Oral Surgeons and Exodontists.

cause considerable embarrassment and account for many errors in diagnosis, and which actually have brought some men to question, now and then, the value of this great diagnostic aid. There must be some reason that so many perfectly capable dentists, discouraged by these difficulties, have been led to try general x-ray laboratories or commercial laboratories that specialize in dental x-ray work, and only to find them as a rule equally unsatisfactory, and for precisely the same reason, namely, the doubtful diagnostic value of the films produced. Surely there must be some underlying factor in failure if we are compelled to admit that even dentists who can well qualify as expert roentgenologists produce poor films very often, and far too often considering their skill and care. This fact is corroborated by the great number of retakes that are necessary before a perfect series of films is obtained.

Attention was strongly focused on this subject when about four years ago the New York Institute of Clinical Oral Pathology conducted a series of clinical tests with an instrument which combined a film holder and a pointer. Theoretically, this pointer indicated the exact angle at which to direct the x-rays. Of course, we all know that many appliances have been developed from time to time, all designed for the same purpose. As far as our records show, and they probably are in accord with general dental opinion, no such device has proved practical. The institute hesitated to undertake this investigation until a careful check revealed that the construction of the instrument was at least theoretically

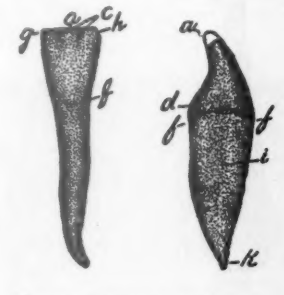


Upper Central Incisor



Upper Lateral Incisor

Fig. 3.—Crown-root angle. (Figs. 3 to 7 from Black's "Dental Anatomy.")



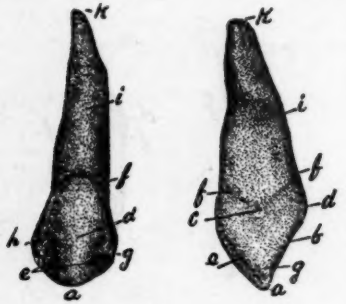
Lower Central Incisor

Lower Lateral Incisor

Fig. 4.—Crown-root angle.

correct. There was one objection to it, however, and that was the bite-block, which, in common with all we have seen, failed to permit proper adaptation of the occlusal surfaces of the teeth, particularly the posterior, and also failed to make allowances for the natural curves of the occlusal plane.

After many changes, a satisfactory block was finally constructed which conformed to the various anatomic conditions found in the mouth and which readily adapted itself to practically all teeth and to all mouth formations. Then the instrument was redesigned to fit this block and the tests were started. After several hundred exposures, we were amazed to find that almost without exception the images of the teeth were distorted, almost invariably being elongated.

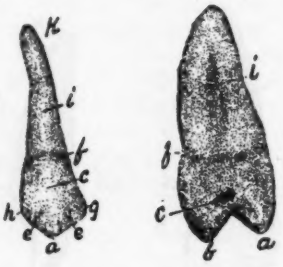


Upper Cuspid

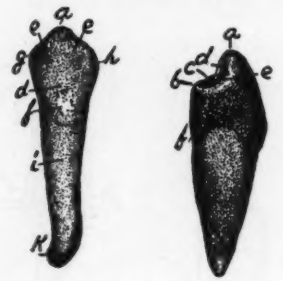
Lower Cuspid

Fig. 5.—Crown-root angle.

Now this is not primarily a report on an instrument. Rather, the instrument, being mechanically correct, was the means of checking the accepted theory of dental roentgenography with a great deal more accuracy and consistency than it could have been done otherwise. While the instrument itself was repeatedly modified, the literature which deals with the anatomy of the maxillae, mandible and the teeth was consulted. This study brought to the attention several important observations which, to our knowledge, have never before been associated with the technic of dental roentgenography. We noted that practically all teeth in the maxillae and the lower six anterior teeth usually tilted outward and that their length axis was by no means at right angles to the occlusal



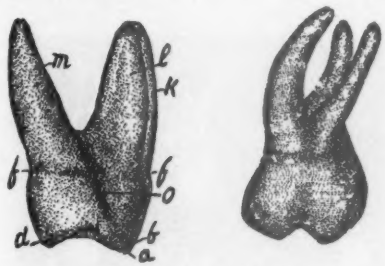
Upper Second Bicuspid



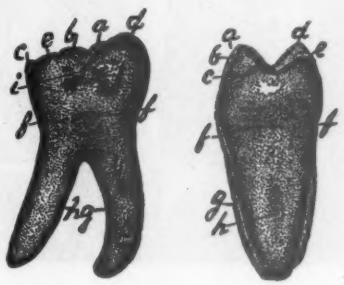
Lower First Bicuspid

Fig. 6.—Crown-root angle.

plane. The flatter the vault of the maxillae, the greater the tendency to tilt. The lower bicuspids and molars, on the other hand, were usually positioned more nearly vertically or even, in some instances, seemed to tilt inward. Next, we noted that the crown of a tooth generally had an axis different from that of its root. A line drawn through the vertical axis of the visible part of a tooth and one drawn through the root, or that part normally covered



Upper First Molar



Lower First Molar

Fig. 7.—Crown-root angle.

by soft tissue and bone, formed an angle which generally varied from 5 to 20 degrees or more, and which we shall hereafter refer to as the crown-root angle. (Figs. 2 to 14.)

We also noted that the greater the tilt of the teeth, the greater was the crown-root angle. Unless a mouth is definitely malformed, the crown-root angle must be at a maximum when the roots slant most, as otherwise many persons would have distorted features owing to protrusion of the crowns of the teeth. We also noted, in many instances, that the crown axis was positioned almost at right angles to the occlusal plane.

In this case, these observations led to an understanding of the existence of a definite relationship of the occlusal plane, the crown-root angle, the position of the teeth in the jaws and the shape of the jaws. To arrive at these simple facts on a predictable mathematical basis required many months.

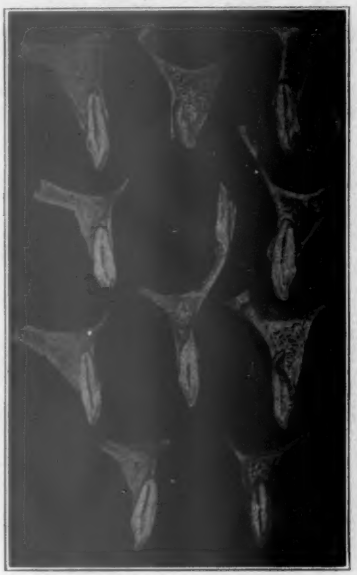


Fig. 8.—Various crown-root angles in upper incisors. (Figs. 8 to 12 from Rudolf Loos: "Bau und Topographie des alveolar fortsatzes im Oberkiefer," 1900.)

The instrument was then changed to allow for these anatomic variations by introducing a fixed correction of 7 degrees and, what was more important, we added to this fixed correction another one which automatically increased in proportion to the deviation of the roots from the vertical. In other words, the

greater the tilt of the root, the greater is the crown-root angle, thereby requiring a greater additional correction of angulation than that which would be necessary for those teeth in a more vertical position.

After the instrument was reconstructed along these lines, observation of hundreds of films showed uniformly excellent results in a wide variety of jaws. It left little doubt that dentists and technicians who have mastered the art of producing

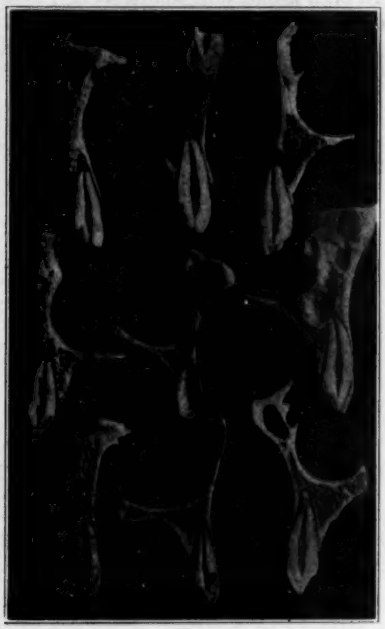


Fig. 9.—Various crown-root angles in upper cuspids.

good dental roentgenograms, either consciously or unconsciously, obviously did not follow the theory of bisection as it had been and still is being taught. To the contrary, practice has compelled them to depart from it on a basis of trial and error, just as this angulator departed from it on a mechanically and mathematically accurate basis. (Fig. 15.)

In view of the fact that an opportunity was then presented for us to use this angulator extensively and that it produced, with very few exceptions, excellent diagnostic roentgenograms of all teeth in many mouths of widely varying shapes, we considered it advisable to report some of the advantages of employing this device or any other device that might be similarly constructed.

It is simple to use; it requires no unusual skill, and it offers definite economy in time and money because retakes

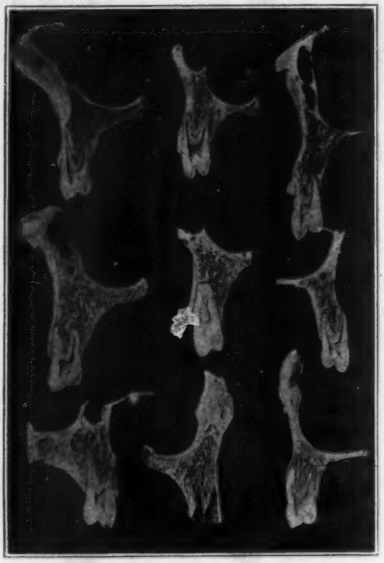


Fig. 10.—Various crown-root angles in upper first bicuspids.

due to improper angulation are comparatively few.

The importance of the consistency of angulation is obviously great, not only to the dentist who has difficulty in producing good films, but also to the orthodontist, periodontist and oral surgeon in the checking of regeneration of bone or other conditions. It is then obviously important to know that successive films were made at the same angle without appre-

ciable longitudinal or lateral distortion. Indeed, if, because of an abnormal formation or location, a tooth does appear distorted, this is a dependable index of the direction and degree of its departure from normal. In substantiation of this consistency, I may mention that, on several occasions, exposures were made of the same area of the same patient, but by different operators, and the films were uniform enough that they could be superimposed, one on the other, and the image could be clearly read through them.

Fig. 11.—Various crown-root angles in upper second bicuspids.

As this or similar devices come into general use, the consultant who examines referred films is reasonably certain of the angle at which they were made and can duplicate them if need be.

In some areas, particularly the anterior part of the mouth, in both the upper and the lower jaws, for proper insertion, the film must ordinarily be appreciably curved. With this technic, the film is held almost exactly flat and a great deal of distortion of the images on the film is thereby avoided.

In the lower incisor region, usually not more than half the film is used. With this technic, we employ the entire film, and greater parts of the osseous structure below the apices can be seen. In many instances, the lower border of the mandible at the symphysis and the genial tubercles become visible.

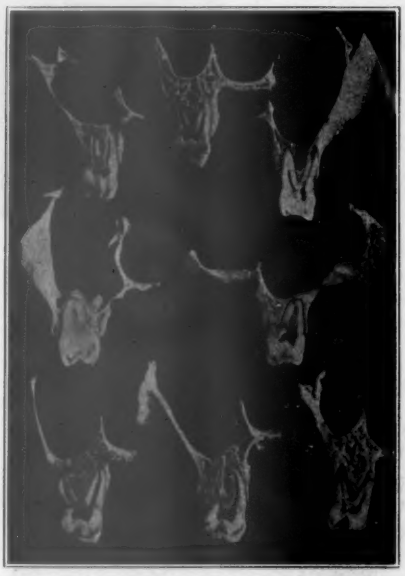


Fig. 12.—Various crown-root angles in upper molars. Because of marked divergence of roots, crown-root angle determinations are especially important in these teeth if we are to produce root images of average length. To study either the buccal or the palatal roots, it is a simple matter to deviate from the technic and in the proper manner.

Medical roentgenography has fully appreciated the greatly increased definition and reduction of distortion that is the result of longer target film distance. An excellent example of this is the present-day practice of making chest exposures at distances up to 72 inches. Dental

roentgenograms are usually made at about 10 inches target film distance because it is less difficult to position the apparatus and cone when they are close to the patient's face. The angulator permits positioning at much greater distances; which results in a marked increase of definition and lessening of distortion. The necessarily longer exposure time is not objectionable.

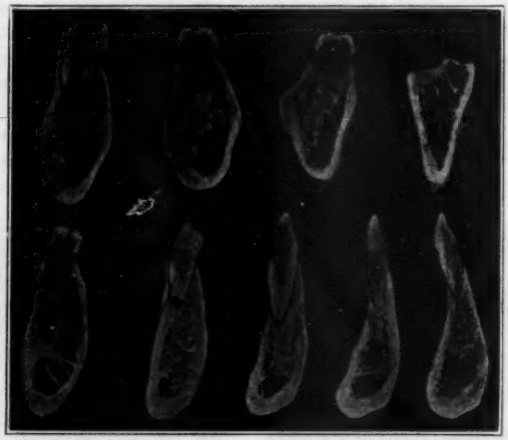


Fig. 13.—Diagram showing various teeth in mandible; the definite crown-root angle applied to practically all mandibular teeth. From Rudolf Loos: "Der Anatomische Bau des Unterkiefers Als Grunlage der Extractionsmechanik," 1899.

Fig. 14.—Determination of crown-root angle. Inspection of the anterior teeth will show that a line drawn through the long axis of the crown could not possibly be the long axis of the tooth. This demonstrates more clearly the crown-root angle and the importance of its accurate determination.

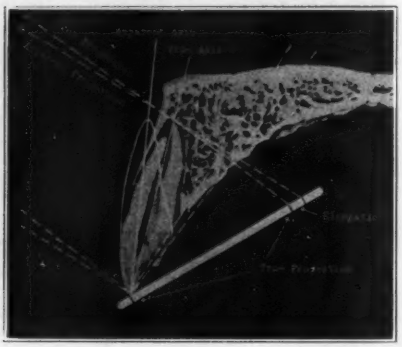


Fig. 15.—Diagram showing that in centering on the apparent bisector, the beam directed at the apparent apex actually falls appreciably below the true apex. This accounts for the elongation so frequently found in roentgenograms of teeth with pronounced crown-root angles.

Two incidental observations may be worth reporting: 1. When the angulator is in position, the patient is instructed to close the lips and to inhale deeply. This will, to a marked extent, overcome

the tendency to gag which is sometimes present. 2. Scores of patients have spontaneously expressed their satisfaction at not having to place the finger in the mouth, for sanitary reasons and because it apparently relieves them of any sense of sharing the responsibility in connection with the taking of the pictures. (Figs. 16, 17 and 18.)

It was also interesting to note that in several cases of arthritis involving the upper extremities and in two cases of a systemic nervous condition in which the patients were unable to support the films, the difficulty was easily overcome by the use of this angulator.

Although stereoscopy in connection with dental x-rays has been employed for many years, the difficulties usually associated with the proper taking of these films have made it impractical. The full benefits that one may derive from the study of such films are still unknown. By the use of a special adapter to this instrument, the technic is simplified to

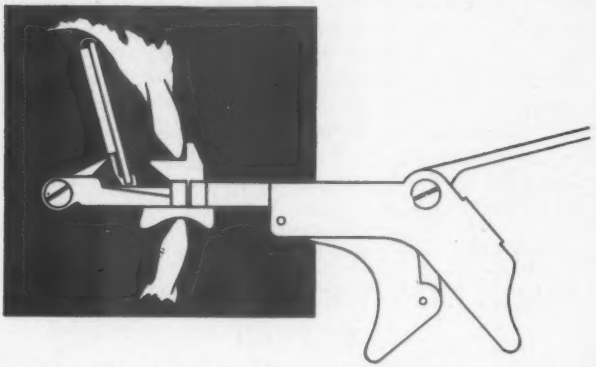


Fig. 16.—Angulating device in position, showing relationship of the crown of the tooth to ledge on bite-block and position of film. The extended pointer indicates the direction of the central x-ray beam.

Fig. 17.—Method of inserting angulating device for upper anterior teeth.

Fig. 18.—Angulating device in position. The pointer projecting is an accurate indicator of the direction of the x-ray beam.

such an extent that any technician should be able to obtain these films with ease.

After four years' study of a mechanical device which we consider to be one of the important advances in the art of roentgenography, it seems necessary to emphasize that even without the use of such an instrument, we can all benefit from what it has taught us about proper technic. No doubt, many of us will derive a very human satisfaction from the discovery that the true blame for many faulty films does not lie entirely with the individual operator, but on his acceptance of a theory which failed to make proper allowances for the anatomic relationship of the teeth and jaws. Unquestionably, a revision of the old theory in the light of this study is bound to lead to better roentgenography and to better service to patients.

In view of these findings and of the complexity of the problem confronting the average individual of taking consistently accurate dental films, it is only reasonable to assume that it actually requires most unusual skill and continued practice to assure satisfactory results without the use of a suitable angulating device.

101 East Seventy-Ninth Street.

THE CUMULATIVE RESULT OF STRUCTURAL DEFECT

By T. Wingate Todd, F.R.C.S. (Eng.), Cleveland, Ohio

DESPITE all diverse professional interests arising from our subdivision of that abstraction, the human being, into his several parts, there is one subject which cannot fail to furnish all of us with substance for thought and attention, namely, the patient himself. It is not my rôle as a physician to discuss with dentists the technic of their specialty or even the general principles governing the management of their particular cases, though there is, in the professional education of physicians and dentists alike, a common experience which presents each one of us with the same problem when, after graduation, we set out to practice our art. This experience is that, as students, we have been trained to deal with maladies, whereas on graduation we are called to treat patients. The two are not synonyms: a malady is certainly not a patient.

These standardized human beings who form a sort of nebulous abstraction consisting largely of untapped wealth around whom our immature imagination played, find no counterpart at all in the individuals we actually meet. Our educators have visualized this standardized being also and have marshalled and dragooned his childhood; our psychologists have carved up his consciousness; our economists have defined his needs and our sociologists have mapped out his satisfactions. We ourselves, dentists and physicians, have divided among us his structure and his substance; and the politicians are fashioning his future. All this, doubtless, is necessary for the simplification of thought, but there is no simpli-

From the Laboratory of Anatomy and Associated Foundations, Western Reserve University.

Read before the annual meeting of the American Academy of Restorative Dentistry, October 22, 1938, St. Louis, Mo.

fication when we are at grips with the problem itself. That rude awakening so shocked the Psalmist that he was moved to remark how the heart of man is deceitful above all things and desperately wicked. Perhaps if the Psalmist had had the perspicacity to see his subject whole, he would never have exclaimed in his haste that all men are liars. These men of his, these individuals whom we must meet, are by no means standardized human beings on whom we are to fasten false teeth or even crowns and bridges.

Alexis Carrel in his most recent book[1] points out that one may not indiscriminately apply scientific knowledge to each patient like a salesman trying to fit the same ready-made coat to people of different sizes. Success depends not merely on scientific knowledge but on ability to grasp the characteristics which make each human being an individual. The separation of the body into parts has been to the advantage of the dentist and the physician. But it is dangerous and costly for the patient and ultimately for the physician.[2]

Fortunately for us life fights on our side and the resilience of the individual eases our task. Let us take as an example the record of a healthy infant (SS 3062 F.W.) which shows fluctuations of progress but no setback in health. I choose an infant because, when biological processes are speeding fast against a background of sidereal or universal time, we may more easily mark the changes which occur. In this child successive examinations of biological attainment conducted at three-month intervals demonstrate, within the limits of determination, the progress made in growth, in psychomotor achievements and in physical resources. The upward swing eddies and swirls though fluctuations seem those of inadequacy in measurement rather than of actual occurrence. But the upward swing is unhesitating. Resilience in this child is potential, not expressed, for it is never really put to the test.

But if, in contrast to this record, we choose another compiled from the observations on an infant (SS 3064 M.W.) who did indeed suffer a severe setback at between six and nine months of age, the culmination of disaster already threatened in earlier weeks, we note the slowing down of all progress in stature, in weight, in psychomotor achievement and in physical resources. Three months later, with convalescence restored, the temporary losses are made good. Resilience asserts itself. But the strain on the organism resulting from the blow to health makes itself manifest and losses are not made good at a uniform rate. Stature increment may increase its tempo and even weight promptly recover. The mind and muscles, relieved from the embarrassment of illness, again vigorously function and psychomotor responses reassert their normal activity. The child seems well, but health is not so easily restored. Well-being is achieved, but energy, which, in the healthy child, is free to radiate through all the child's relations with its environment, is still handicapped. Much of it must be expended in the process of restoring those physical reserves so necessary to meet the sudden calls, fatigues and strains of each day's effort. Thus well-being is not health, though often mistaken for it in the looseness of our thought and observation. The mark of the distinction between health and well-being is depicted here in the calcium rating. The mineral store on which staying power and endurance depend is still depleted. Not until six months after this child had, by his measurable reactions, reestablished well-being was health restored as indicated in the rehabilitation of the skeletal mineral store.

The full cost of that illness in infancy is not completely assessed in the diagram we have prepared. There is another

method of assessing progress, another criterion of health which does not appear in the chart. This is the physical maturity as portrayed by roentgenography of the skeleton. It is in the skeleton that we most readily find the relics of past disturbances of health. The method of making this assessment has been fully set forth in a previous publication[6] and need not occupy us now. In this child, skeletal assessment showed that the progress lost in infancy has not yet been made up at seven years. The child still lacks by four months that stage of physical development characteristic of his years, a small matter one might think but not negligible in practice. It is the indicator of a constitution still handicapped and incompletely equipped to cope with the assaults of the environment. Clinically this was expressed at the four-year examination by summer sniffles and at seven years the child was afflicted by a perennially stuffy nose, skin sensitivity to weeds and an alimentary tract which suffered frequent digestive disturbances.

The individuality which we have claimed for the organism is therefore not merely an aspect of the organism as a whole but is an essential characteristic of each component part. Tissues, humors, organs become modified by the experiences and adventures of life and carry the marks of these adventures for many a long day, perhaps even to the close of life and affect in more or less degree the physical and even the mental responses of the organism itself. Who can assess the experiences of any patient which make him what he is? We see the end result but do not know how this result has been brought about.

The stamp of inferiority is readily imprinted in infancy, more readily at that stage of life than at any other. By way of illustration I cite the chart of progress in growth of body, in weight and in skeletal development or maturation of a boy who showed in infancy the features of malnutrition induced by feeding difficulties and enhanced by parental inexperience (SS 3102). The apparently minor losses in infancy turned out, as later observation showed, to be the indicators of a disturbance of constitutional health so profound that this boy continued his developmental growth at a tempo lower than that to which he was entitled.

It is our experience that this tempo of developmental growth is set by the second birthday and that thereafter any child has but little chance of correcting a tempo thus geared to slower progress.[5] But, for our encouragement, it is well to note that the indifferent character of these products of our civilization is not incurable. It is far more dependent on acquired disorder than on hereditary defect.

Now let us turn our attention to the more remote results of acquired disorder. We have seen that there are two structural features appraisable in childhood where relics of past disorder are easily assessed. These are the texture of the bone and the progress of skeletal maturation. My illustration is drawn from the records of two of the girls in our adolescence study. One of these girls was thirteen, the other nineteen years old at the time when the roentgenograms were made. They show, however, the same stage in the progress of maturation of the skeleton. In neither are any of the epiphyses united with the shaft but the stage of preparation for union is identical in both. Something occurred in the older girl to slow down the progress of her development, so that, at nineteen years, she had reached only that stage usually attained by thirteen years. The texture of her bones moreover shows a far lighter mineralization than that in the other. There is less osseous material in her bones, the shadows of which demonstrate a drain of mineral without

which staying power and endurance are unattainable.

This girl appears well; she is able to play tennis, though not more than one set at a time; she does volunteer work in a hospital; she is capable within limits, though not clever, and is socially acceptable. But her day must be set to a moderate pace and even more moderate achievement to avoid inevitable fatigue and discouragement. She is pleasant and attractive but lacks the exuberance and zest and sparkle which a girl of her age longs to possess. A generation ago we should have called her a chronic invalid. She does not ask the physician to cure a disorder because a physician, trained in current thought, would assure her that she is organically sound. But she is constitutionally deficient, easily fatigued, subject to depression, low in resistance and poor in resilience. What help can we expect from the tissues of such a patient who puts herself under our care? How shall we safeguard ourselves when dealing with the tissues of a patient like this and how shall we assess the character and magnitude of the complication with which such a constitution saddles our endeavors.

Before attempting to deal with the questions thus propounded let me present certain features in the developmental progress of two brothers, twins, whom we shall compare at their ten-year and thirteen-year examinations. Both had a moderately checkered health history in infancy and early childhood, the one (SS 4019) to a much greater degree than the other (SS 4020). Both show a progress in skeletal development (maturation) slightly above average and both a weight below average, but the sickly twin (SS 4019) is distinctly below the more robust (SS 4020) in his progress. This inferiority affects stature and spreads to motor abilities, intellectual progress, emotional poise and self-confidence. At ten years the more robust of the two had a skeletal maturation rating six months in advance of the other and he maintained this distinction through the thirteenth birthday. His six-month advance in stature at ten years was raised to a twenty-one-month advance by thirteen years. In weight his ascendency was but twelve months at ten years, though by thirteen years this had increased to a value of twenty-four months. The tempo of developmental growth is therefore very differently set in these twins.

Roentgenograms of their hands show little difference in size or physical maturation at ten years and the difference is scarcely increased at thirteen years.

When, however, the lateral views of the hands are compared, the increased difference at thirteen years is much more clearly expressed. Not only is the size divergent, but the wrist tissues are thicker and the hand muscles larger and denser, so that bone shadows are more obscured in SS 4020.

The increasing difference is perhaps even more evident in the muscles of the forearm and in the bones of the elbow.

The distinction between these boys is one of bodily size and of muscular nutrition and strength rather than of staying power or endurance. Hence the differences in muscle are those of bulk rather than density. They are reflected in the dynamometer ratings, but not in the mineralization of bone, and but lightly in the density of muscle shadows.

For the density of skeletal mineralization foot roentgenograms are valuable. It is true and most gratifying that the difference apparent at ten years becomes less pronounced at thirteen. The distinctions are best seen in the center of the body of the calcaneus and in the longitudinal trabeculae paralleling the lower border of this bone. A feature, however, which is specially clear in the talus of SS 4019 at ten years is the thickening of trabeculae, a feature which, in our ex-

perience, is indicative of the tendency to transform the store of mineral into a hoard of mineral for, when trabeculae are thickened, there is less likelihood of release of mineral from the bone to the circulating plasma.

Depletion of mineral from the bone store is earliest found and best seen in the hand and foot. We have already noted its occurrence in the foot. The only site in the hand where depletion is evident is at the lower end of the radius and that only in SS 4019 at ten years.

That the health defect primarily responsible for the differences already enumerated in the progress of growth, weight, physical maturation and also in the psychological ratings took place in early childhood is evident from a comparison of the Bolton skull tracings made at five years seven months. In facial development, growth and maturation are more closely linked than in the limbs. There is at this stage little difference between the two skulls but the calcification of teeth is distinctly more advanced in SS 4020.

By the age of thirteen years the distinction in facial growth, particularly of the chin region, is quite marked. In SS 4020 canine and premolar eruption is just completed, giving an approximate rating of eleven and a half years, whereas in SS 4019 none of these permanent teeth have erupted and their predecessors have not fallen. This would give a rating of certainly less than eleven years[4] and perhaps of less than ten years.[3]

In the comparison of these twins, we are faced with the evident fact that human beings even of like heritage are far from identical as individuals in consequence of the disabilities and divergencies mordanted into their structure and tissue efficiency by disorders experienced in childhood. We have noted how far-reaching these divergencies can be and how thoroughly they can permeate the individuality. We have noted in passing that objective evidence of structural and functional differences may be found not merely in stature and weight but in physical maturation of skeleton and teeth, in bone texture and in density of muscle shadow.

We may, however, look further into the roentgenograms of childhood for evidence of tissue health and disorder. A male infant, SS 4162, at three months, shows a subcutaneous tissue so clear that one may observe the blood vessels coursing through it. By six months, however, this infant had developed a disability clinically equivocal at this stage, though definitely evident in later months, as gastro-intestinal disturbance, skin sensitivity and behavior defects. The increased density of subcutaneous tissue at six months warns of the constitutional change then setting in. The significance of this fact is emphasized when we recall that it is upon the health of our connective tissues that we depend for our resistance to disease.

Not only in the subcutaneous tissue but in all others of the group of these health protecting connective tissues can we observe similar changes. The intermuscular and joint tissues are easily observable by roentgenography. If joint tissues are healthy they are clearly defined and the outlines of synovial membrane and articular surfaces are sharply delineated. This is strikingly seen in a roentgenogram of the knee. But if the joint tissues be waterlogged and dense, the clear definition is obscured or altogether lost.

Now these are criteria of tissue health in childhood. We have noted them in the texture of bone, of muscle and of connective tissue. We have seen their expression in the increment of stature, in gain in weight, in progress in physical development, in mental alertness and in emotional poise. We have seen the evidence of their general importance. But, of their precise significance, I have given

scarcely a hint. To what purpose they may be applied and how far they relate to adult life is not apparent from what I have yet said. This is natural, for we are looking at the initial stages of a new study of which hardly more than the main outlines have been traced. But that this study will eventually become of the greatest significance to all who have to deal with the human constitution, directly or indirectly, is not even now in doubt. This much we can already affirm with confidence: that a child whose bone mineral is deficient, whose muscle shadows are light, whose connective tissues are dense, whose stature increments are poor, whose weight gain is erratic, whose mental alertness is impaired or whose emotional poise is undermined is a sick child whether or not there are clinical symptoms pointing to disorder of any particular organ or system. And we shall not be able to rely on tissue health for the consolidation of any repair we undertake or any procedure we employ for the restoration of healthy function until these adverse signs of constitutional impairment are eliminated by appropriate medical treatment.

In the adult, processes of growth are replaced by those of repair; processes of maturation are replaced by those of increasing resistance. Age is not synonymous with infirmity but with resistance and functional efficiency. Resilience is as characteristic of the adult as it is of the child. Therefore we need not fear to lack evidence of tissue health in age as in youth. It is natural that we should limit our search first to childhood where criteria are most clearly defined because of the rate and extent of the changes involved. But let us for a few moments turn our attention to the identification of comparable criteria in the adult.

We turn then first to the texture of bone. It is well known that the spongy tissue of bone may be close textured and fine or coarse textured with thickened trabeculae. The significance of these differences has been overlooked. They are identical with those we have seen in childhood. The contrast in texture of well mineralized and poorly mineralized bones is quite striking. When in young adult life the mineral store becomes so low that it is necessary to maintain it as a hoard, thus releasing but the minimum to the circulating plasma, not only will demineralization be evident, but the trabeculae will be thickened.

These distinctions are as patent in roentgenography of the living as they are in the dead. The wrist bones of a healthy woman in full vigor scarcely show the architectural pattern so dense is the gray shadow of interstitial labile mineral in the spongiosa. When, however, from any cause, the mineral is depleted, labile mineral is drained away and the architectural pattern becomes obtrusive. If there is a halt called to depletion through the development of a tissue resistance, trabeculae will become thicker. The absence of this thickening means failure in resistance and is the harbinger of actual collapse of bone structure.

Fluctuations in labile mineral are frequent; they occur rapidly, so that even in six weeks a distinct difference may be discerned and the change is reversible: it can be brought about by suitable therapeusis appropriately administered. A case in point is the change in mineralization evident in later pregnancy and the puerperal period. Very frequently, however, therapeusis adapted merely to restoration of bone mineral is ineffective because the constitutional depletion is not limited to bone mineral, but is widespread and affects the efficiency or even the integrity of those tissues, such as the alimentary tract, upon whose efficient service assimilation and distribution of bone mineral depends.

The connective tissues of the adult are in no way different from those of the

child in their susceptibility to disturbance. They are active throughout life. Nevertheless many of us are content to exist with connective tissues of low resisting quality and we finally succumb because these have lost their functional resilience. And we are content to have it so because the signals of distress in adulthood are less imperative than those in childhood, even though the disorder is more malign and fatal as a result of its insidious character. Eighty per cent of the chronic patients of over sixty years in her wards, Dr. Ralli tells me, have much less than one milligram per cent of ascorbic acid in their blood, but are content because they show no sign of scurvy. Can we doubt that such patients would have soft tissues of the mouth of such low vitality that they would be worse than useless in promoting the effectiveness of any work the restorative dentist might undertake? How often, however, do we make any assay of the patient's ascorbic acid before addressing ourselves to the problem he brings to us.

Surely even the patient's attitude, his nervousness, his apprehension, his lassitude are the signals of distress which should warn our expert understanding of lurking disorder more fundamental and far-reaching than that local expression with which we are called upon to deal.

Finally, let me direct attention to the state of nutrition of the muscles by which one can often readily differentiate human firsts from human seconds. Adequate nutrition means adequate size and adequate density of roentgenographic shadows. Here again pregnancy and the puerperal state may give us our example. When the muscle shadows are light, endurance is defective and staying power at a disadvantage. Fatigue quickly supervenes and puts a stop to any activity. The day's effort is geared to a low pace and, if the pace be forced, collapse is the result. Far too many of the young mothers of our nation are suffering this disability largely through misunderstanding of the facts of nutrition or misinterpretation of the signs of health. Muscles do not waste or diminish in functional power if their nutrition is maintained. The muscles of a man of fifty need not be less efficient than those of a man twenty years his junior. Only as constitutional health declines do muscles shrink and lose their reliability. The man who admits that he is not so good as he once was accuses himself in his ignorance.

Our attitude toward disease must change. Established disorder must take a second place in our thought. There is stalking among us, in our homes and in the street, a specter far more ghastly, disability more prevalent, more detrimental, more costly to ourselves and to our nation than all the disease treated in our hospitals today. The dismal and painfully dramatic episodes which fill our daily papers are staged if not acted in our homes and owe their origin for the most part to the unrecognized and minor symptoms of unregistered ill health.

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CORRELATION OF X-RAY FINDINGS IN THE MANDIBULAR JOINT WITH CLINICAL SIGNS, ESPECIALLY TRISMUS

By J. B. Costen, M.D., St. Louis, Mo.

In the study of a series of cases showing a symptom complex of pain and irritative signs about the head, wall of the pharynx and tongue, the constant association of destructive lesions within the mandibular joint directed attention to this region as the source. When enough findings are present about the sinuses to account for headache and ear complaints, only perfunctory attention may be given to the eyes or the nervous or circulatory system as the source of trouble, least of all to occlusion of the jaws and the condition of the mandibular joints. So we have noted recently the astonishing widespread revival of interest in deranged function of the mandibular joint as a paradoxical explanation of certain headaches typical of sinus disease; neuralgia strongly similar to classic fifth nerve neuralgia, burning tongue for which no usual cause could be found; dizziness unexplained by eye findings, and deafness otherwise ascribed to paranasal sinus disease affecting the eustachian tubes and middle ear structures. It is on this borderline ground that a common situation arises in which physician and dentist are mutually dependent for diagnosis and treatment.

The numerous scattered observations throughout the medical records associate the mandibular joint with disease effects as well as normal functions. Hilton, classic writer of ancient medical lore, described the loss of sensation in an area supplied by the auricular nerve in a patient recovering from a knife wound in the neck. Butlin, of the same period, described pain in the tongue in a patient whose rheumatic symptoms involved the mandibular joint. Early experiments in the physiology of salivary secretion, notably of Heidenhain (1878), utilized the chorda tympani and auricular temporal nerves for stimulation to explain the control of the production of saliva.

Descriptions by the patient of pain about the ears and head on movement of the jaw gave easy clues to the joint involvement. Gross observation of the irregular movement of loosened condyles and variations from the normal picture shown in the x-ray film further established the sources of pain. The uniform complaint of pain in the ear in patients with mumps; the crackling noise observed in the patient with worn structures—these were items of proof and interest in connection with the joint lesions, as were the lack of molar support, the irregular alinement of the teeth, direct injury, bone degeneration in loose movement of the condyles and destruction of joint tissues, to allow impingement on the nerves.

However, these various factors occasionally were missing and explanation had to be produced for certain cases showing marked changes within the joint, with the usual pain reflexes, in which the occlusion was entirely normal. A case of

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marked trismus of unknown etiology came under observation in which the spastic position of the lower jaw was relieved promptly after added support was placed between the jaw teeth. This suggested that abnormal movement of the condyles might have the effect of trismus. If such a subpainful irritation was supplied, a mild trismus might be produced, not noticeable as trismus, but just enough to begin a destructive cycle in the jaw movement.

The ultimate position of the condyles being determined by occlusion during physiologic rest of the jaw, malocclusion of the teeth, or loss of any posterior teeth, initiates the first changes toward a pathologic reaction within the joint. With the first irregular movement of the condyles, long before pain is noted, irritation of sensory nerves within the joint capsule produces trismus of the jaw muscles, and uneven pressure is exerted on the meniscus and other joint structures. Then a vicious cycle is established from painful stimuli, producing contraction or trismus in the closing muscles on one side, thence unequal compression of mandibular joint structures or simply excessive stress on the condyle against the meniscus and tubercle as opening proceeds, producing a more painful stimulus, reflected again to the muscles as trismus, and so on. Such a painful stimulus, not originating in malocclusion, is illustrated by x-ray studies of the case of a 16-year-old patient with an impacted unerupted third molar, with beginning destruction, symptoms within the mandibular joint on the same side (snapping) and trismus of one year's duration.

Trismus, as usually defined, is the tonic contraction of the muscles of mastication, an important factor in locating the bone changes within the mandibular joint, and is usually regarded as connected with tetanus, tetany, hysteria, inflammation of the parotid gland, dental caries and impaction and injuries to the periosteum of the jaw, and also as a symptom of organic disease due to irritation near the motor nucleus of the fifth nerve. Thus, impulses are transmitted to the motor root of the mandibular division of the fifth nerve, from central sources, or from irritation of its sensory branches, contracting the muscles of mastication.

In selecting cases from these studies which showed attacks of trismus or locked bite after certain painful excursions of the jaw, or in which trismus was constantly present, relationships could be seen which seem to explain the method of perpetuating unbalanced muscle pull, distortion of jaw movement and actual destruction of joint structures.

Although such cases may not have shown any increased density in the x-ray picture or change in bone outline, in various instances a slight change in occlusion relieved the trismus and pain. A follow-up x-ray study revealed the most marked changes in the spacing of the condyle within the glenoid fossa, even exactly reversed relationships of one side to the other. The cases under the best study control clearly demonstrated that measurements were inaccurate after some weeks or months and that points of occlusion again had to be established. This showed that the factor of trismus which could be seen was definitely important in the ultimate outcome of the case. All that was done by treatment was to make ever so slight a change in the rest position of the condyle. When the trismus had disappeared, the excursion of the jaw became smooth. From this point, the deduction is made that even when the gross evidence of trismus is not present, if there is enough painful irritation about any branch of the mandibular nerve, subpainful or subconscious trismus must be present. It is, therefore, the important factor in destructive effects about the lower jaw.

It is for these reasons that precision

methods to actually calibrate the position of condyles within the fossae and to measure changes in position, for purposes of reduplication, seem unnecessary. The studies offer a guide as to changes from the normal, but the correction of the distorted relationship seems to depend purely on obtaining balanced occlusion in a position of physiologic rest of the jaw. Naturally, the first stage of such treatment involves the relaxation of the trismus, after which the first measurements would be inaccurate and again require adjustment of the reconstructive treatment which had been used.

SUMMARY

1. Trismus, whether marked enough to be seen grossly or so slight as not to be observed, influences greatly the position of the condyles with reference to the glenoid fossa.

2. The source of trismus may be the irritation of any branch of the mandibular nerve, whether incidental to inflammation, injury or bone disease. It may originate and be perpetuated by irregular movement of the condyles.

3. Trismus is an important factor in treatment and in changes with each readjustment of the jaw position.

4. The effects of compression of the condyles within the glenoid fossae may be observed by repeated x-ray study.

3720 Washington Boulevard.

OBSERVATIONS OF CHILDREN FROM FIVE TO TWELVE YEARS OF AGE

By Geneva E. Groth, D.D.S., Philadelphia, Pa.

TO treat or not to treat is a vital point of interest to each of us. This paper has been written not as a research report, but as a plea for a more nearly universal practice of observing our young patients before placing orthodontic appliances in their mouths. As we all know, no appliance, no matter what system or type we use, will give the tissues the perfect freedom that they need to develop in a natural way. Nor can we foretell in minute detail at what rate or in what direction a part will develop naturally. Hellman[1] says,

> Apparent discrepancies in growth very often disappear in the course of development if unhindered by artificial encumbrances. It naturally follows that orthodontic treatment must never be undertaken until the orthodontist is reasonably certain that natural growth changes involved in the development of the face and the dentition will not complete the task in their own way.

Do not misunderstand: I am not underestimating the importance of mechanical interference with orthodontic appliances, nor am I advocating that we keep all cases under observation until the permanent teeth are fully erupted before beginning orthodontic treatment. Appliances, like a splint or crutch, are vital where they are absolutely necessary.

To supplement our reading of the outstanding works of Hellman, Todd, Howard and others, there is no other way of learning more about the development of the human masticatory apparatus than to observe carefully the young children whom we have under our care. Seeing the patients at stated intervals and keep-

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ing accurate records, including models, is a service that should be given to children whether they are in the care of the orthodontist or the general practitioner.

Friel brings out the fact that at no time in the life cycle of the dentition, from the eruption of the deciduous teeth to the wearing off of the cusps in senility, is there a static occlusion. There are constant changes going on during the entire time. This follows the natural law of change.

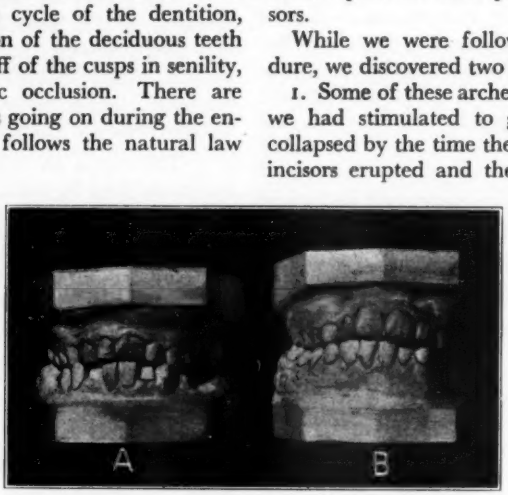

Fig. 1.—A, crowded condition of mandibular incisors. B, condition one year and five months later. A 2 mm. increase in arch width, due to normal development, has resulted in normal alinement of the incisors. A corresponding increase in the maxillary arch was insufficient for normal alinement of the maxillary second incisor.

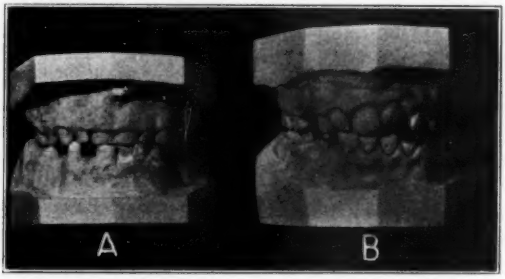

Fig. 2.—A, edge-to-edge bite. B, normal increase in overbite as permanent incisors erupted.

ACCOMMODATION SPACES

Many years ago, E. A. Bogue[3] propounded the theory that if in a child at the age of 4 the upper arch did not measure at least 28 mm. between the lingual sides of the two second deciduous molars at the gum margin, we were to assume that the arch would not broaden without assistance. For many years, appliances were placed to widen the arches so that there would be spaces between the deciduous incisors and thus insure sufficient space for their permanent successors.

While we were following this procedure, we discovered two facts:

1. Some of these arches that we thought we had stimulated to grow wider had collapsed by the time the four permanent incisors erupted and the teeth were not in normal alinement. Evidently, the parts were not ready to develop to that size at that time; for, on later treatment, the tissues responded to the same method of procedure as before.

2. In a group of children for whom we had made models and for whom, for some reason, we did not proceed with

this orthodox treatment, quite a few cases, although there had been no accommodation spaces, had normally erupted incisors, the arch developing in width as the teeth erupted. Also, in some cases, the incisors erupted in a crowded condition, but after their eruption, the forces of normal development gradually brought them into normal alinement. (Fig. 1.) Consequently, unless the lack of width of an arch has complications which interfere with normal function, it seems best to wait until there is no probability of natural increase in size of the arch. It is also impossible to diagnose a lack of correlation between the size of the teeth and the size of the jaws until after the permanent teeth have erupted. Deficiency in size of the apical base will result in crowding of the teeth, and this disturbance or deficiency in growth is not ordinarily evident at this early age.

OVERBITE

For many years, we believed that in a normal overbite, the maxillary incisors overlapped the incisal one-third of the labial surface of the mandibular incisors. Today, we believe that the overbite can range from a slight overlap in some cases to a deep overbite in others and still be normal. We also know that during the life cycle, the overbite should change. In his investigation, Friel found that "the deciduous maxillary incisors overlap the mandibular incisors at two and a half years of age, but this overlap disappears, the incisors ultimately meeting edge to edge." He observed that "this edge-to-edge occlusion can only develop where there is a stimulus to forward development of the mandible accompanied by adequate function," and "a similar condition occurs in the adult as the results of wear only."

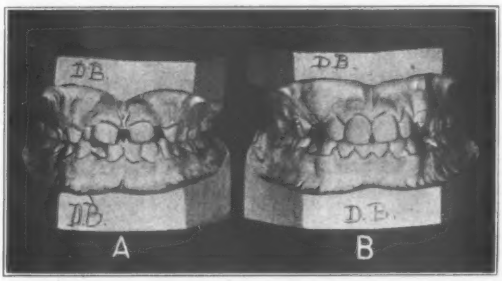

Fig. 3.—A, diastema between maxillary first incisors; low frenum attachment. B, normal development without orthodontic or surgical aid; showing improvement in alinement of mandibular incisors.

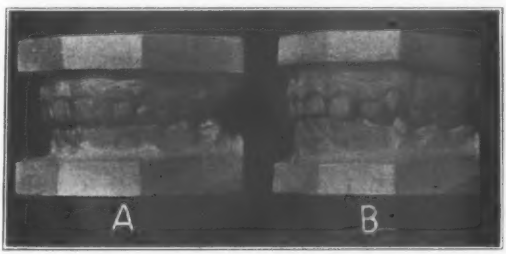

Fig. 4.—A, result of abnormal retention of deciduous maxillary second incisor and deciduous canine. B, condition four and one-half months after removal of deciduous teeth. The permanent teeth are moving toward their normal positions without the help of appliances.

We note that, as the permanent incisors erupt, the overbite increases. This is associated with the downward growth of the face and also a labial inclination of the maxillary incisors. (Fig. 2.) When the premolars have erupted, the overbite should be less than at 6 or 8 years of age. Frequently, the desired vertical growth does not occur until the second permanent molars erupt. In view of these clinical findings, we are rather reluctant to open the bite with an appliance before the second molars have erupted, unless the depth of overbite is so great that the soft tissues are irritated or normal function is impaired. Unfortunately, we have seen cases in which a deep overbite was corrected at an early age develop an open bite at the age of 13 or 14, owing to the increase in vertical development at that time. There are some deep bites that are not correctible, and we must assume that they are either normal for the individual or that they are due to developmental defects of structure that cannot be modified by ordinary orthodontic procedure.

Fig. 5.—Result of too long retention of deciduous molars. Note the development of the premolar roots. The left mandibular premolar is missing.

DIASTEMA

It is normal for maxillary first incisors to erupt with a space between them. As the second incisors and canines erupt the space closes. (Fig. 3.) The observation of many cases of so-called abnormal labial frenum has failed to confirm the teaching of a decade ago and has caused us to change our opinion and to deplore the somewhat prevalent belief in the necessity for surgical removal of this usually inoffensive structure. At birth, the frenum is attached to the edge of the alveolar process, and while it does grow down as the face grows, it does not grow downward so far as the alveolar process and hence should remain high as related to the teeth. Therefore, we cannot diagnose a diastema between the first incisors as due to an abnormal frenum until all growth changes have ceased in this part of the dental arch. This does not occur until the canines and perhaps the second molars have come into their positions in the arch. Surgical procedure should not be recommended until a positive diagnosis can be made, and that is not possible until these changes have taken place. In this connection, it must not be overlooked that the spacing may be due to a deep overbite, and it may also be due in some cases to a lack of correlation

in the size of the teeth in the two arches.

PREVENTIVE MEASURES

If cases are kept under observation, local conditions will often be discovered which, when corrected, will allow normal occlusion to develop. We should watch x-ray pictures for supernumerary teeth. Often, on the removal of the extra tooth or teeth, the adjacent teeth will resume their normal positions without the use of orthodontic appliances.

We should also see that the deciduous teeth are not retained too long. When the permanent tooth to replace a deciduous one is erupting, the deciduous tooth must be extracted immediately, no matter what its relative position to the permanent tooth or what the length of the root of the deciduous tooth. (Fig. 4.) If the permanent tooth is not erupting, usually in the canine and premolar areas, our judgment for the timely extraction of the deciduous tooth must be based on physiologic and not chronologic age. (Fig. 5.) The best guide is the roentgenogram. From this, we can tell the extent of the development of the permanent tooth and also whether a permanent successor is present. Occasionally, a case is seen in which none of the deciduous teeth exfoliate naturally, but must be extracted at the auspicious time.

Any pernicious habits should be detected during the period of observation: thumb-sucking, tongue habits, habit of chewing on one side, etc. The deformity resulting from thumb-sucking depends on the direction and the degree of pressure exerted, the duration of the habit and the secondary habits of the tongue and lips and mouth-breathing. (Fig. 6.)

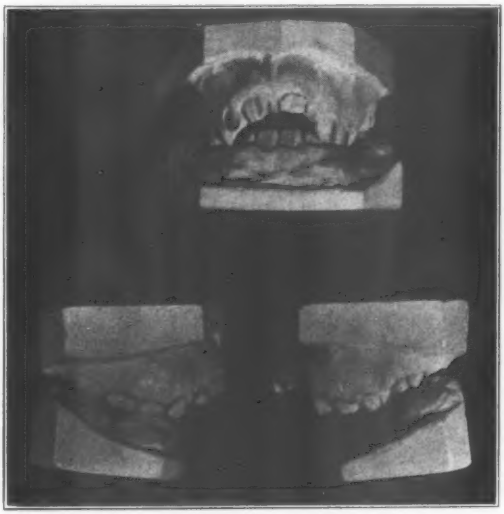

Fig. 6.—Case of thumb-sucking; open bite due to inhibited vertical growth; narrow arch; high palate; secondary tongue habit. The patient was also a mouth breather.

Swinehart,[4] observing thirty-eight cases of thumb-sucking, mentions the fact that there are three major mechanical forces: (1) passive force of the digit between the arches, (2) abnormal pressure of the cheek and (3) muscular pressure of the digit against the palate.

If the habit has produced a mild mal-

occlusion of the anterior teeth and no other habits of lip or tongue have been involved, on cessation of the habit there is a tendency toward normal development and growth. If the resulting malocclusion is extreme, we cannot expect the tissues to return to normal without orthodontic aid.

If the habit is not broken, any attempt on our part to correct the malocclusion will be in vain; for the teeth will resume their malposition as soon as the appliances are removed. Although many children have the habit of thumb-sucking and, in some cases, the tissues have developed normally after its cessation, the habit should be broken as soon as detected. If you have tried to help a child of 9, 10 or 11 years to break a habit, you can readily understand the great difficulty for the child. It is much easier to stop the act early than to wait until it becomes a habit.

I cannot overemphasize the importance of maintaining the continuity of the deciduous arches, because, in this field, lies the greatest opportunity for preventive orthodontics. When orthodontics becomes a public health problem, it will be found that much more than 50 per cent of the malocclusion presented for treatment is attributable to lack of care of the deciduous teeth. One has only to examine the teeth of children of any city public school for proof of this statement.

In cases of premature loss of deciduous teeth, we find that, in some, the space is static and does not change in size. In other cases, the space grows smaller through drifting of the adjacent teeth. (Fig. 7.) We also find that more damage is done by premature loss in an arch that is underdeveloped as in the mandibular arch of a Class II, Division 1, case and in the maxillary arch in Class III and in Class I where some of the maxillary teeth are in a lingual position. Class II, Division 2, unilateral cases are frequently the result of premature loss of one or more maxillary deciduous molars, resulting in the forward shifting of molars and premolars and pushing out of canines.

Fig. 7.—Distoclusion; malocclusion increased by premature loss of deciduous molars.

That space maintainers are not always

necessary has been shown by reported cases wherein spaces closing from premature loss of the deciduous teeth have opened again with the eruption of the permanent successor in alinement. This demonstrates that arch form is dependent on other than mechanical conditions, but it does not give us license to neglect space maintaining on faith alone. It does emphasize the importance of the study of each case, particularly as to the stage of development of the succeeding tooth itself as well as the arches. It is practically impossible to move a mandibular molar distally to make space for an impacted second premolar if the impaction has resulted from the premature loss of the second deciduous molar, without impaction of the third molar and at times even the second molar.

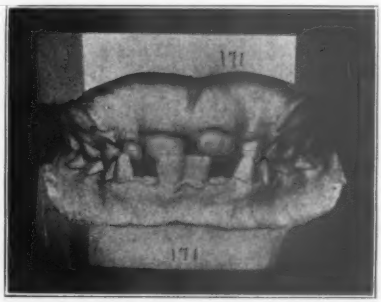

Fig. 8.—Maxillary teeth in lingual position. This condition should be treated as soon as recognized.

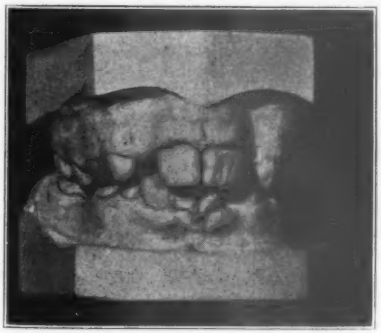

Fig. 9.—Neutroclusion; rotation of mandibular first incisor causing trauma. Treatment is imperative.

If a space maintainer is indicated, it should be simple in construction, giving as much natural freedom of movement to the attached teeth as possible. Once placed, like an orthodontic appliance, it must be observed at stated intervals. It must be recemented and removed at the time for the eruption of the permanent teeth.

TREATMENT

During this observation period, certain conditions or anomalies of occlusion will be encountered which can be definitely diagnosed as a malocclusion interfering with normal development of the mechanism. When we are convinced that these anomalies are not corrective, we should treat them orthodontically.

Fig. 10.—Mesioclusion, which should be treated early.

Without going into too great detail regarding treatment, I should like to mention a few procedures that seem important to me.

Neutroclusion.—When we have one or more of the maxillary teeth in lingual position as regards the mandibular teeth, whether they are deciduous or permanent, the malposition should be corrected

as soon as recognized. (Fig. 8.) The malposition is a mechanical hindrance to normal development. After this correction is made, the case should be kept under observation. In the majority of cases, we can expect normal development and growth without further mechanical help, especially if the child is young.

In neutroclusion with crowded anterior teeth, where the crowding produces mechanical interference, we should correct the condition early. (Fig. 9.)

Distoclusion.—We should treat extreme distoclusion cases in small children if the distance between the arches is so great that the lower lip rests constantly under the maxillary incisors and no conscious effort on the part of the patient can hold the lip out. Distoclusion cases that are not extreme should be kept under observation, and it is sometimes found that the lower arch will develop forward of its own accord. When the first permanent molar and the incisors erupt, the lower arch should develop forward slightly. In growth and development, periods of rest are frequently followed by periods of accelerated growth. This may explain why, in some cases of slight distoclusion, the condition corrects itself.

If the teeth are not worn through function when the first permanent molars erupt, the triangular ridge of the mesiobuccal cusp of the maxillary molar does not occlude in the buccal groove of the mandibular one, but is mesial to the groove. As the incisors are lost and their permanent successors erupt, the lower arch may come forward a little and bring the buccal groove nearer the triangular ridge. Frequently, these cases remain in distoclusion owing to lack of functional wear of the deciduous teeth, which permits the mandible to come forward more easily.

Mesioclusion cases should be treated when first recognized, whether they are in the deciduous or in the permanent dentition. (Fig. 10.) Class III cases have a tendency to recur when the second permanent molars erupt.

SUMMARY

1. Young patients should be kept under observation for a time even though a mild malocclusion may be present, since there is the inherent tendency of an organism and all its parts to develop according to type. Treatment should be resorted to only when we are convinced that there is an obstruction which cannot be overcome and that mechanical assistance is necessary.

2. Normal occlusion is constantly changing from the time of the eruption of the deciduous teeth until senility, and at no time should we confuse normal occlusion with ideal occlusion. To properly diagnose anomalies of occlusion, one must be familiar with these changes and the sequence in which they occur.

3. Orthodontic appliances, even at their greatest perfection, are more or less a hindrance to natural development and consequently should not be placed unless it is imperative.

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1301 Medical Arts Building.

CARBOHYDRATE DEGRADATION BY MOUTH ORGANISMS. I

By L. S. Fosdick, Ph.D., Chicago, Ill.

SINCE the advancement of the chemicobacterial theory of dental caries by Miller,[1] Black[2] and Williams,[3] much research supporting this theory has been carried out. Howe[4] and Bunzell,[5] Bodecker[6] and a host of others have obtained data that support the views of the pioneers in this field. Recently, Jay[7] and others found that *L. acidophilus* is the predominant organism associated with dental caries, but Anderson[8] finds almost as close a correlation with certain strains of streptococcus. Hansen and his coworkers[9] showed that many mouth organisms would degrade carbohydrate material found in the mouth and noted symbiotic effects among several organisms. In a study of decalcification of enamel in a saliva-sugar medium,[10] it was found that several organisms in pure strain would decalcify enamel at a much greater rate than *L. acidophilus,* and also a test for susceptibility to dental caries was suggested based upon the rate of acid production in saliva-sugar-enamel mixtures.

It has been known for many years that fermentation is not produced by organisms as such,[11] but by enzymes contained in or excreted by the organisms. When sugar is degraded to lactic acid by muscle enzymes or to alcohol by yeast, the initial reactions are about the same. This is demonstrated by the researches of Harden,[12] Young,[13] Robison,[14] Nilsson,[15] Neuberg[16] and Leibowitz and Meyerhof and Kiessling.[17] Furthermore, it has been shown that other organisms follow a similar path in the degradation of carbohydrate to lactic, pyruvic, propionic and acetic acids.[18]

It was suggested in 1936[19] that mouth organisms, in the production of acids, may follow the same reactions as in muscle tissue in the production of lactic acid or as in yeast in the production of alcohol. There was some evidence for this in the symbiotic effects between yeast and *L. acidophilus,* as well as in the reductase activity of mouth organisms.[20]

It was assumed that, if the foregoing reactions take place in the mouth during the production of acid, the intermediate compounds could be isolated from mixtures of saliva, sugar and calcium phosphate, if the mixture were allowed to ferment. With this objective, the following experiments were performed.

EXPERIMENTAL PROCEDURE

One liter of saliva was collected by means of paraffin stimulation. Fifty grams of glucose and 10 gm. of tribasic calcium phosphate was added to the saliva. The mixture was incubated at 37.5°C. for two weeks. The mixture was then extracted with ether and the ether extract was evaporated to dryness. Qualitative tests on the extract showed acetic, pyruvic and lactic acids present. The mixture had a strong odor of butyric acid, although no positive reaction for this compound was obtained. The extracted saliva was made alkaline (pH 8.2) with sodium hydroxide. A large precipitate of calcium phosphate was removed by filtration and the filtrate was concentrated to 100 cc. by vacuum distillation. The pH of the solution was

From the Chemistry Department, Northwestern University Dental School.

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adjusted to 8.2, and 400 cc. of alcohol was added. The mixture was allowed to stand in the icebox twenty-four hours, whereupon a small precipitate was observed. This was removed by filtration. Qualitative tests indicated that it was an organic phosphorus compound. The rate of hydrolysis of this compound indicated that it may be a hexosephosphate. The filtrate was concentrated to 50 cc. and 1 liter of alcohol was added. A white flocculent precipitate separated. This was identified as a mixture of calcium lactate and calcium pyruvate.

The foregoing experiment was repeated with the exception that the extracted filtered saliva was precipitated with barium chloride at a pH of 5.5. This was done in the hope of obtaining some phosphoglyceric acid. No phosphoglyceric acid was obtained, but lactic, acetic and pyruvic acids were identified.

Owing to the velocity of the intermediate reactions, it was thought necessary to prevent the hydrolysis of the phosphoric ester by the addition of fluoride ions. For this reason, another 1-liter sample of saliva was allowed to ferment as in the previous experiments. After three days of fermentation, 0.5 gm. of sodium fluoride was added and the mixture allowed to stand at body temperature for four days. At this time, the inorganic phosphate was precipitated with magnesium mixture in ammoniacal solution. The phosphate was removed, the pH adjusted to 5.5 and the phosphoglyceric acid precipitated with barium acetate. No precipitate was obtained, although the solution became cloudy. The solution was concentrated *in vacuo* to 200 cc. At this point, a precipitate was obtained that had the characteristics of phosphoglyceric acid.

RESULTS

Lactic, pyruvic, acetic, phosphoglyceric and possibly butyric and hexosephosphoric acids were isolated from saliva-glucose-tribasic calcium phosphate mixtures.

CONCLUSIONS

The products of fermentation of mouth organisms in a saliva-glucose-tricalcium phosphate medium correspond with the products formed in tissue and during alcoholic fermentation. It is quite probable that the degradation of carbohydrate to lactic acid by means of bacteria, yeast and tissue enzymes follows similar paths.

If this is true, several acids, such as phosphoglyceric, pyruvic, acetic, butyric and lactic acids, take part in dental caries.

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HORACE WELLS TRIUMPHS OVER PAIN

By Max E. Soifer,* D.D.S., Hartford, Conn.

A HUNGARIAN writer, in a recent book,[1] attempts to make William T. G. Morton rather than Horace Wells the hero in the story of the discovery of anesthesia. This presentation of half-truths has already been answered by Archer,[2] Lufkin[28] and Raper,[3] and by editorials in several leading publications.[4–7] The purpose of this paper is to present briefly a few of the many statements recorded in dental literature during the past ninety years that clearly accord to Wells the distinction of discoverer of anesthesia. Curiously, many of these references are omitted in the above-mentioned book.

Arthur H. Merritt, President Elect of the American Dental Association, in a stirring article,[8] after citing no less than nine authorities as far back as 1860, concludes: "Wells can fairly be called the discoverer of anesthesia, in that he was the first to publicly demonstrate the possibilities of surgical anesthesia. He is also entitled to a considerable share in the honor given to Morton as the discoverer of the anesthetic properties of sulphuric ether."

L. Pierce Anthony, Editor of The Journal of the American Dental Association, in a paper read before the Connecticut State Dental Association in 1935,[9] says,

Though somewhat belated, Wells received all the honors that could come to one who made such a momentous contribution to humanitarianism, not only in this country but in Europe. It was my unexpected pleasure to attend the unveiling of a monument to his memory in Paris in 1910, when the International Dental Federation and the dental profession of Europe paid due and lasting honor to the memory of Horace Wells, the dentist of Hartford, Connecticut, who discovered the means of alleviation of pain that has been such a humane blessing to humanity.

Referring to Riggs, who was Wells' partner, Dr. Anthony writes,[10] "He (Riggs) was a student, confrère, and close friend of Horace Wells and was personally responsible in helping Wells to develop his experiments which led to the discovery of the anesthetic properties of nitrous oxide gas." Nor should we forget statements by Riggs in 1847,[11] repeated in 1885,[12] that the gas was used continuously from the date of the discovery, 1844, until the appearance of Morton on the scene, twenty-two months later, in 1846.

Fülöp-Miller, in his book "Triumph Over Pain," fails to mention many of the testimonials and resolutions giving credit to Horace Wells,[13–15] for his great work, a few of which are: Common Council, Hartford, Conn., March 21, 1850; Connecticut State Legislature, Ses-

*Librarian, Hartford Dental Society.

sion of 1847; American Dental Association, 1864 (reaffirmed in 1872 and 1938); Hartford Society of Dentists, 1870; Hartford County Medical Society, 1859; Connecticut Medical Society, 1870; New York State Medical Society, 1860; American Medical Association, 1870; Boston Gynecological Society, 1870; Dental and Medical Professions of England, 1873[16]; Spanish Odontological Society, 1907[17]; Semi-Centennial Wells Celebration, Philadelphia, 1894[18] and Paris Medical Society,[12] 1848.

He omits any reference to that excellent compilation of Charles J. Wells,[15] who, after a thorough search in Hartford and other cities, furnishes a bibliography of no less than 135 references in the literature to the humanitarian accomplishments of Wells, and lists the numerous testimonials that accord Wells unstinting praise for his monumental scientific contribution.

Fülöp-Miller also fails to include Walter H. Jacobs' convincing presentation,[19] written after a most comprehensive search and noting several indisputable statements, and concluding that "no greater honor has been paid any man than Horace Wells."

He omits from his list several issues of the *Dental Recorder* during the years of 1847-1850[11] with numerous favorable notations supporting the Wells claims. Of particular interest is the issue of April 1, 1849, wherein the editor, after reviewing the claims of those involved in the controversy raging at the time, concludes with these words: "To Wells and Wells alone belongs the merit of having first made the discovery." This opinion, expressed by the leading dental journal of that period, can hardly be ignored in any summation touching on the discovery of anesthesia.

Fülöp-Miller lists among his references the work of L. W. Nevius, in 1894,[20] but fails to note in the text of his book that Dr. Nevius, in at least three instances,[20] speaks of Wells with the greatest respect and concludes with such phrases as "The first operation performed by the use of nitrous oxide gas (of which we have any record) was performed on Dr. Wells. . . . The discovery of anesthesia by Wells was entirely original with him. . . . Dr. Wells continued the use of gas successfully for about two years as he afterwards proved by the deposition of over forty of Hartford's best citizens on whom he operated."

Fülöp-Miller lists in his bibliography, but dares not speak in detail of an excellent pamphlet published in 1850[21] which credits Wells with the discovery at least two years before Morton and Jackson. Interestingly enough, the original manuscript was located recently. Its author, Isaac Toucey, served not only as governor and U. S. Senator of his native state of Connecticut, but also received appointments to cabinets of the United States Government (Attorney General, under President Polk and Secretary of the Navy under President Buchanan). Surely no one will doubt the veracity of a man "who was the ablest lawyer of his time in this state and whose reputation spread far beyond its borders."[22]

The author of "Triumph Over Pain" mentions bibliographically, but fails to give much notice to the countless number of depositions included in Truman Smith's 1858 compilation[23] to the Thirty-Second Congress, Second Session, which contains indisputable evidence as to the ideas and accomplishments of Wells in the field of anesthesia, even as early as 1840, at least four years before the actual demonstration in 1844.

Again, he studiously omits the dedication speech of Walter R. Steiner[14] at the Horace Wells memorial pew in Trinity College Chapel in 1937, when Dr. Steiner, an authority on Connecticut dental history and who has assembled an invaluable collection of material on the subject in the library of the Hartford Medical Society, furnished indisputable

evidence of this great humanitarian's work.

Also, Fülöp-Miller lists Flagg[24] among his references, but omits Guilford,[25] both of whom paid great tribute to the magnanimity and originality of Wells in offering to suffering humanity the great boon of relief from surgical pain. Certainly such statements are not to be passed over lightly by any one attempting to present a true story concerning the discovery of anesthesia.

Fülöp-Miller omits mentioning that, in an address at the centennial dinner of the Hartford County Medical Society in 1892, Joseph E. Root, secretary of the society,[26] in referring to the first record of the action of the society in 1859 "that in the opinion of this society, there no longer exists any reasonable doubt that to Dr. Wells alone belongs the honor of having discovered and demonstrated the great principle of modern anesthesia," stated that the reasons set forth for this action are indeed laudatory. To use Dr. Root's own words:

> The reason for action at that time (1859) was the fact that Drs. Morton and Jackson, of Boston, to whom Wells told his discovery and explained his experiments, had used nitrous oxide gas and sulphuric ether and were trying to steal from Wells the honor and emoluments pertaining to the discovery. It was to enforce and secure to the doctor this just claim that our society took action upon this subject.

When Prof. G. Q. Colton was well advanced in years, he still resented any attempt to discredit Horace Wells.[18] This was evident from a letter addressed by Colton to the editor of the *Philadelphia Record*[27] in which he states:

> In your issue of September 4th, there appeared an article of special interest to me as my name was mentioned in it. You have produced a very good likeness of Dr. Wells as I knew him intimately. I gave him the laughing gas for the extraction of the first tooth ever drawn without pain. It was on the 11th day of December 1844 and in which Dr. Wells demonstrated the truth of the discovery of anesthesia. It was the discovery of the present century.

Too long have we delayed in our duty to pay honor and tribute to one of America's noblemen. One may justly conclude, after considering the abovementioned and other omissions, that it was Horace Wells who pointed the finger to a "triumph over pain," through anesthesia.

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284 Church Street.

ALLEGED HEMOSTATIC ACTION OF GELATIN, COAGULEN, FIBROGEN AND HISTIDINE ADMINISTERED BY MOUTH

By M. L. Tainter, M.D.; A. H. Throndson, D.D.S., and A. P. Richardson, M.D., San Francisco, Calif.

IN a previous paper, we discussed the alleged hemostatic value of calcium, viosterol, styptysate and ceanothyn, when used orally under conditions of dental practice.[1] It was found that prolonged administration of these agents in maximum doses failed to shorten the blood coagulation time.

From the Department of Physiology and Pharmacology, College of Physicians and Surgeons, A School of Dentistry, and the Department of Pharmacology, Stanford Medical School. The greater part of this work was done at the dental school and supported, in part, by grants from the Research Commission of the American Dental Association and the California State Dental Association.

The present study is a continuation of work with hemostatic agents of animal origin. The methods and procedure were substantially the same as those of the previous paper, and the details need not be repeated here. Briefly, the procedure consisted of having subjects take the agents by mouth in maximum or recommended dosage each day, and measuring the coagulation time twice daily during the period of medication, and during similar periods before and afterwards. The drug administration was continued from ten days to two weeks, and the average coagulation time for this period calculated. This was compared with the

average coagulation time observed in the same subject during the two weeks preceding and immediately following the medication. These averages were analyzed statistically to determine whether the differences observed were of sufficient magnitude to be beyond the range of spontaneous or chance fluctuation. The reasoning involved in these statistical considerations has been discussed in the previous paper.[1]

It is sufficient to point out that, if the critical ratio between the periods being compared is greater than 2, there is about a 21 to 1 chance against such a difference arising from chance alone, and therefore it can reasonably be assumed that the difference is a true one. When such a reliable difference is found, the second question may then be considered as to whether the change observed is of sufficient magnitude, or in the proper direction, to be of therapeutic value under clinical conditions.

The agents studied are currently used by mouth as hemostatics, and are asserted to be definitely valuable. As these agents have been used by us solely by mouth, as in dental practice, we are not concerned here with their possible value when applied locally, or perhaps injected hypodermically. There have been so many papers written about the hemostatic value of these materials that it is not possible to recapitulate the substance of these reports. The literature has been thoroughly considered and critically reviewed by Gold,[2] and those interested are referred to that summary. Only the reports pertinent to the agents investigated by us are considered here with each agent.

GELATIN

Gelatin has had a considerable vogue as a hemostatic for preoperative use in tonsillectomies, extractions and other operations where excessive bleeding might be anticipated. It is commonly mentioned in dental textbooks as a drug which may be given before operations to minimize or prevent bleeding. Such administration is almost exclusively made orally, since the hypodermic injection of this agent is not a simple procedure, nor is it suited to the ordinary conditions of dental practice. It is difficult to understand why gelatin should act as a hemostatic when taken by mouth, since it is a food protein, the composition of which is the same as that of most other protein foods. Therefore, administration of gelatin should give about the same result as that of any protein meal. However, because of the hemostatic claims, it was thought necessary to make the trial under clinical conditions.

Six subjects made control observations on themselves twice daily for from ten days to two weeks. Then they took, for a similar length of time, 15 gm. of powdered gelatin three times a day, continuing the observation of coagulation time. After the period of medication, there was a similar observation period. The average coagulation time for each subject is shown graphically in Figure 1.

It can be seen that in one subject, the coagulation time was prolonged; in two, it was unchanged, and in three, it was slightly decreased as compared with the control periods. The accompanying table contains a summary of the actual values and their statistical validity. For the entire group of six subjects, the average coagulation time during all control periods was 196 seconds. During gelatin administration, the value was 194 seconds, or a difference of only two seconds. The averages show that, in three trials, there were definite decreases, the critical ratios being larger than 2, which was arbitrarily selected as being reliable. In one trial, there was an equally valid difference in the opposite direction, and in the two others, the differences were not beyond the range of chance fluctuation. In those subjects in which valid decreases were observed, these were only of the order of magnitude of from twenty to thirty seconds out of a total time of about

three minutes. It is extremely doubtful whether a change so small could be of any therapeutic value. Therefore, the changes were not of such size or uniformity of direction as to justify expectation of clinical effects from gelatin.

COAGULEN

Coagulen is a tissue extract prepared from bovine blood, and marketed by the Ciba Company, to whom we are indebted for the material used in this study. It is said to contain natural coagulating ferments present in blood and is claimed to be effective when administered by mouth in the firm's advertising literature and in some clinical reports.[3] However, this claim has not been allowed by the Council on Pharmacy and Chemistry of the American Medical Association.[4]

In the present trials, 5 gm. of coagulen was taken daily by mouth by each of seven subjects, as recommended by the manufacturer; that is, the contents of a 5-gm. bottle were dissolved in 200 cc. of distilled water and taken in three portions during twenty-four hours. The subjects in this group made control observations for from nine to sixteen days before and after the medication, which was continued for ten days. The average coagulation time was decreased eighteen seconds, as shown in the table. However, Figure 1 shows that in only two of seven subjects was the decrease of any considerable magnitude. The greatest average decrease was only fifty seconds, and, in at least four of the seven subjects, the changes were so small as to be within the range of spontaneous variation, as shown by the low critical ratios in the table. In

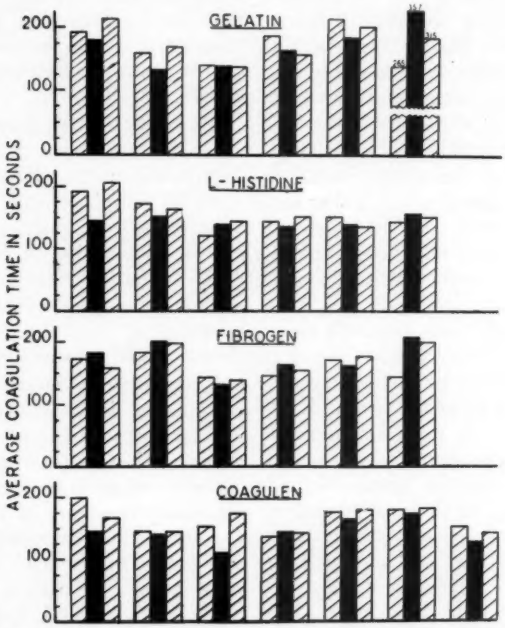

Fig. 1.—Average coagulation times of blood in study of alleged hemostatics administered by mouth. The solid columns represent the average time in each subject during the period of medication, and the cross-hatched columns the average values in the control periods, before (left column) and after (right column) medication.

only two of the subjects were the changes great enough to be both beyond the range of chance fluctuation and large enough to indicate some possible, if only moderate, clinical value. However, since ten days of continued medication, which is longer than commonly practiced clinically, produced no useful effects on blood coagulation in five of seven subjects, it seems clear that the use of coagulen by mouth cannot be relied on for controlling postoperative hemorrhage.

AVERAGE COAGULATION TIMES OF BLOOD IN COMBINED CONTROL PERIODS AS COMPARED WITH PERIODS OF MEDICATION WITH DIFFERENT ALLEGED HEMOSTATICS*

Subject	Control Period				Medication Period					
	Days	Observations	Coagulation Time Seconds	SD Means Seconds	Days	Observations	Coagulation Time Seconds	SD Means Seconds	SD Diff. Means Seconds	Critical Ratio
			Gelatin (15 gm. three times daily)							
Tr.	31	61	164	5.0	16	31	130	6.5	8.2	4.1
Fy.	20	40	209	2.6	10	20	185	2.8	3.8	6.3
Hl.	20	40	141	5.3	15	30	141	5.1	7.3	0.0
Cs.	20	39	177	5.0	10	20	167	6.3	8.0	1.25
Br.	27	53	283	6.7	11	22	357	12.0	13.7	5.4
Tn.	30	59	204	3.2	14	28	181	2.8	4.2	5.5
Average			196				194			
			Coagulen (5 gm. daily)							
Fy.	23	45	149	5.2	10	20	126	7.3	8.95	3.9
Br.	19	38	146	4.8	10	20	140	7.0	8.5	0.71
Cs.	20	40	163	3.5	10	20	113	4.9	6.0	8.4
Rn.	32	59	140	3.1	10	20	145	6.2	6.9	0.72
Tn.	20	40	181	6.1	10	20	175	4.5	7.5	0.93
$Fy._2$	17	33	181	4.4	10	20	142	5.1	6.7	5.8
$Cs._2$	20	40	177	4.4	10	20	164	9.3	10.2	1.3
Average			162				144			
			Fibrogen (15 cc. daily)							
Er.	14	28	164	4.2	7	14	181	3.0	5.2	3.3
Tn.	29	58	190	3.3	16	32	201	3.7	4.9	2.2
Fy.	20	39	165	6.1	10	20	209	9.5	11.2	3.9
Br.	19	37	152	4.3	10	20	164	9.8	10.7	1.12
Cs.	20	40	175	3.8	10	20	163	5.2	6.4	1.9
Rn.	30	60	141	3.3	10	20	132	5.2	6.1	1.5
Average			165				175			
			l—Histidine (0.2 gm.) (5 cc. 4 per cent twice daily)							
Tr.	30	59	168	4.6	15	30	152	6.7	8.1	1.97
Tn.	28	55	199	5.3	14	28	145	6.6	8.5	6.35
Br.	20	39	134	4.9	10	20	140	8.6	9.9	0.61
Cs.	20	40	149	3.3	10	20	138	5.1	6.1	1.8
Rn.	30	59	146	3.0	11	21	139	4.9	5.7	1.23
Fy.	20	39	148	4.6	10	20	163	12.0	12.8	1.17
Average			157				146			

*SD diff. means is the standard deviation of the difference between the mean or average of the control period and the period of medication. Critical ratio is the difference between these two means divided by the SD diff. means. The critical ratio should be 2 or greater to give a reasonable probability that the differences are greater than would be expected from chance fluctuation.

FIBROGEN

Fibrogen is also an extract of tissue, marketed by Merrell and Company, to whom we are indebted for a supply of the product. Fibrogen was introduced in an extensive series of papers by Mills and his associates, who asserted that its ingestion by mouth could shorten the coagulation time of blood. These claims, which have been reviewed by Gold,[2] need not be considered here. It is worthy of note that the Council on Pharmacy and Chemistry and the Council on Dental Therapeutics have not accepted the claims of the manufacturer that this material is effective by mouth. However, since it is still so used in dental practice, it was included in the present study. Attempts were made to determine whether prolonged administration under our conditions might have effects which do not occur with the single administrations commonly made.

Fibrogen was taken daily in quantities of 15 cc., freshly prepared material being used to eliminate the possibility that deterioration was responsible for negative effects. The product was kept cool from the time of receipt from the distributor. It was taken by mouth and for the same periods as the agents discussed above, with the exception of one case in which it caused so much nausea in the subject that only seven days' administration was possible.

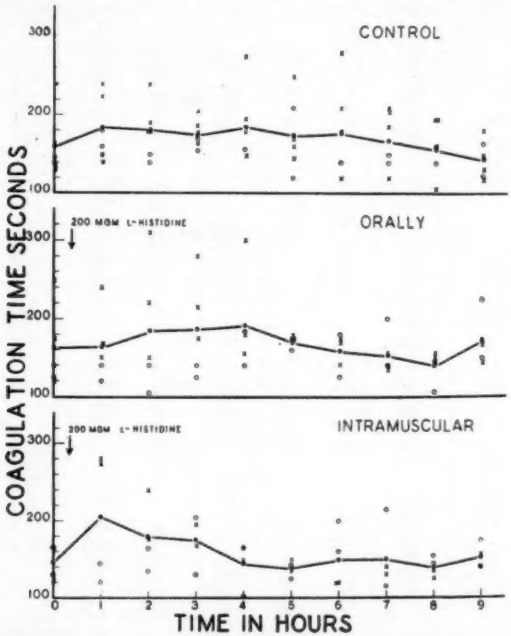

Fig. 2.—Coagulation times of blood in two subjects when 200 mg. of histidine was given by mouth and intramuscularly at 9 a.m., coagulation times being measured at hourly intervals throughout the day; results obtained in five such trials without medication, and in 4 trials, each after oral and intramuscular administration. The curves represent averages of the coagulation times.

The table shows that the average coagulation times for the entire group of subjects were increased ten seconds. In four of the six subjects, the average time was increased, and in only two decreased.

In view of the fact that both the increases and the decreases were relatively small, and within range of spontaneous variation, the fibrogen had no consistent or significant effect on the coagulation time. It can be concluded that administration of fibrogen in maximal doses by mouth for many days at a time did not effectively speed up the coagulation of blood, and therefore it lacks clinical efficiency as an oral hemostatic.

HISTIDINE

Histidine is an amino-acid derived from proteins, and therefore is a basic constituent of some of the agents considered above. Under the name "Larostidin," it has been recently introduced into medical practice for the treatment of gastric ulcer. In connection with studies of its value in gastric ulcer, Burger and Schrade[5] and Kohl[6] asserted that injection of this agent or its administration by mouth shortens the coagulation time of blood about 50 per cent. The same claim has been made by Hicks,[7] but is denied by Bloch *et al.*[8] Because of the contradictory nature of these reports, it was thought desirable to determine whether oral administration could actually decrease the coagulation time.

Histidine was used as the hydrochloride salt of the levo-isomer which is marketed under the name of "Larostidin" by Hoffman La Roche, Inc., to whom we are indebted for the material used in this study. Six subjects took material twice a day from ten to fifteen days. Each dose was 5 cc. of a 4 per cent solution, or 0.2 gm. of histidine taken with a small amount of water. The coagulation time was measured from three to five hours after the administration, when the coagulation time is claimed to be decreased most, according to previous reports. The control observations were made for two weeks before and after the periods of medication.

The table shows that the coagulation time for the entire group of six subjects was decreased an average of only eleven seconds during the histidine medication. In only one subject was there a decrease of sufficient magnitude to give a critical ratio greater than 2, this change being an average shortening of forty-four seconds. Figure 2 shows that in five of the six subjects, the changes were easily within the range of spontaneous variation. Since administration of histidine failed in the majority of subjects used, it was not demonstrably effective by mouth on blood coagulation. Therefore, the previous reports of hemostatic action could not be confirmed.

However, the considerable number of reports asserting that there was a reduction of 50 per cent in blood coagulation time were sufficiently definite, even though inadequately controlled, to make it desirable to test these claims by another procedure. Burger and Schrade's data showed that the maximum effect on coagulation time was obtained at the end of three hours. Although our first coagulation times were measured at the alleged time of maximum effect, there might have been the possibility in our subjects that the effect was delayed, or perhaps missed by an improper selection of the time interval. Therefore, additional tests were made to show the progressive change in the coagulation time after histidine administration, if any. The coagulation time was determined at hourly intervals throughout the entire day, and the histidine was taken after the first control reading in the morning. In this way, it was hoped to detect any shortening in the coagulation time which might have been missed previously. Two subjects were used for repeated observations over a number of days. Experimental days with hourly control observations, but without histidine, were carried through alternately with the days of medication, so that variations in coagulation time for different hours of the day would be determined and allowed for. The results of these observations are presented

graphically in Figure 2. Six complete day-long tests were performed as controls, with the average coagulation times fairly uniform throughout the entire day, at about 150 seconds. When 200 mg. of histidine were taken by mouth, immediately after the first or control observation in the morning, there was no change in the coagulation time in the five tests made beyond that due to spontaneous fluctuation or chance variation. Therefore, there was a complete failure to confirm the 50 per cent reduction in coagulation time claimed abroad.

It was thought that possibly the histidine might be more effective by injection, since this is the usual method of administration in the treatment of gastric ulcer, although this therapeutic use is now discredited. Therefore, four more tests were performed by the same technic except that the histidine was injected intramuscularly. Figure 2 shows that there was again no decrease in the average coagulation time, the greatest change, as a matter of fact, being an apparent prolongation of the time beyond that of the control. This change, however, was not of statistical significance in view of the variability of the individual measurements. At least, the histidine injection did not shorten the coagulation time.

Our results with histidine, therefore, confirm the negative results of Bloch *et al.*[8] Since there was a complete failure to demonstrate a shortening of coagulation time by oral administration and intramuscular injection of histidine under controlled conditions, statements regarding the alleged shortening of coagulation time by others cannot be accepted.

COMMENT

The observations made by us again demonstrate that there is no reliable means of shortening the coagulation time of blood with agents given by mouth. Our trials differ from those commonly made in that the administration of agents has been continued for periods of about two weeks, and during these periods repeated measurements of the coagulation time have been made. In the trials of this report, there have also been made hundreds of measurements of the coagulation times before and after medication, which give reliable average values for the normal times. From these extensive control observations, the significance of variation during the period of medication can be determined with some certainty. No one of the four alleged hemostatic agents tested was found to have any value when administered by mouth. Therefore, there is no rational basis for their further use for this purpose in dentistry.

There are methods of controlling hemorrhage which are effective and which should be employed when the need arises, rather than depending on giving the patient something by mouth which has been clearly demonstrated to be useless. The clinical problem of hemorrhage in dentistry can best be met by local application of hemostatic agents. That is, the bleeding may be controlled, first, by direct pressure, either digital, or pack, or by suturing, which keeps the vessel closed long enough for a clot to form in the lumen, or, second, by direct application of a vasoconstrictor such as epinephrine or kephrine, which will keep the lumen occluded by constriction of the smooth muscle until the clot can form.

If these two methods are not successful, an attempt can be made to speed up blood coagulation by local application of agents which are effective. Fibrogen or thromboplastin-local can be applied on a tampon to the bleeding area, and may speed up the coagulation process. More potent than these agents is the newly introduced venom of the fer-de-lance snake, which is reported to be effective in promoting blood coagulation in purpura hemorrhagica, and even in hemophilia, when applied locally, Since by proper use of these local measures, almost any hemorrhage can be adequately handled, the need for an orally adminis-

tered drug should not arise. In fact, it is quite evident from the negative results of our studies, as well as those of the more critical observations reported by others, that reliance on hemostatic agents administered by mouth is unwarranted, and may not be to the best interests of the patient.

CONCLUSIONS

1. The coagulation times of healthy subjects were measured twice daily and continuously for periods of many months. During this time, two-week intervals of oral medication with some alleged hemostatic agents were alternated with periods without medication. The average coagulation times during the periods without medication, before and after medication, were compared with those when the agents were administered. The average values so obtained were analyzed statistically for their probable reliability to determine whether the changes could be accounted for on the basis of chance fluctuation in the individual measurements.

2. Administration of gelatin by mouth three times daily in doses of 15 gm. did not change the coagulation times in six subjects.

3. Administration of 5 gm. of coagulen daily by mouth also did not shorten the coagulation time in five of seven subjects, and in two produced changes of no real clinical significance.

4. Fibrogen administration in daily doses of 15 cc. by mouth caused no changes in the coagulation time of six subjects.

5. Histidine administration in doses of 0.2 gm. twice daily by mouth caused a shortening of the coagulation time in only one of six subjects. Therefore, these negative results in the majority were not in keeping with the statements made regarding it as an effective hemostatic when given by mouth.

6. In two other subjects, oral or intramuscular administration of the same dose of histidine did not reduce the coagulation time when observations were made at hourly intervals throughout the day. Therefore, no confirmation was made of prior statements that histidine shortens the coagulation time 50 per cent at the end of three hours.

7. The results of this study, taken with those previously reported in THE JOURNAL and from this institution, leave no doubt that the agents commonly advocated for oral administration as hemostatics in dentistry are not effective when so used. The dental practitioner is advised to direct his efforts at controlling hemorrhage to local application of demonstrably effective agents rather than to try to speed up the coagulation process by systemic medication.

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ANATOMY AND ANESTHESIA OF THE BUCCINATOR (LONG BUCCAL) NERVE

By Ernest G. Sloman, D.D.S., San Francisco, Calif.

IN all operations requiring local anesthesia of the lower posterior teeth, or more particularly anesthesia of the soft tissues of the vestibule in the region of the lower posterior teeth, it is advisable and customary to anesthetize the fibers of the buccinator branch of the mandibular division of the trigeminal nerve. If the tissues in this part of the mouth are without symptoms of inflammation, administration of an infiltration anesthetic in the vestibular area alongside the tooth or teeth to be extracted usually establishes satisfactory anesthesia.

Occasionally, there are inflammatory conditions in this region or low in the adjacent retromolar fossa, in which event the operator must choose one of the following four methods to establish anesthesia: 1. Use a general anesthetic. 2. Anesthetize only the inferior alveolar and lingual branches of the mandibular nerve and trust that the pain resulting from avoiding anesthetizing the area supplied by the buccinator nerve will not be too severe. 3. Inject the anesthetic into the inflamed tissue; which, of course, is subject to serious objection. 4. Employ a block technic by which the solution is deposited on or near the trunk of the buccinator nerve at some considerable distance from the inflamed area.

From the Department of Anatomy, College of Physicians and Surgeons of San Francisco, A School of Dentistry.

Read before the International Association for Dental Research, San Francisco Section, November 30, 1938.

It is indeed advisable to use a general anesthetic in preference to a local whenever satisfactory anesthesia cannot be readily established without injection into or in the immediate vicinity of the area of inflammation. There are, however, many extractions of lower posterior teeth and other operations performed in or about a lower posterior mandibular inflamed area, for which local rather than general anesthesia is employed. The decision to use a local instead of a general anesthetic is often influenced by the smaller cost in time and money of a local as compared with a general anesthetic. The frequency with which these operations are performed under local anesthesia, in the presence of mild and sometimes pronounced inflammatory conditions, indicates a need for perfecting a technic in which the dangers attending injection into this inflamed area may be eliminated.

In most surgical operations in the region of the posterior one-half of the mandible, it is necessary to anesthetize three separate branches of the third division of the trigeminal nerve. These are (1) the inferior alveolar branch, which runs forward in the substance of the body of the mandible; (2) the lingual, which carries sensations from the tongue and the mucoperiosteum on the medial side of the mandible, and (3) the buccinator, which carries sensory impulses from the mucoperiosteum of the posterior part of the vestibule, the mucous membrane of the retromolar fossa and the soft tissue immediately above it,

as well as the skin and mucous membrane of the back part of the cheek.

The most frequent inflammatory conditions that occur in this area are found either posterior to or alongside the molar or molars to be extracted, or in the soft tissue overlying the retromolar fossa. If a lower posterior tooth is to be extracted, the operator frequently makes a mandibular injection, without any special effort to anesthetize the lingual nerve, because it and the inferior alveolar nerve are so close together in the approach of the needle from the oral cavity to the mandibular foramen. Since the injection is made into the fat which envelops these nerves in this region, diffusion of the solution is usually sufficient to affect both nerves. In a very small percentage of cases, the solution may be diffused sufficiently to infiltrate the sheath of the temporal muscle and anesthetize the buccinator nerve.

Hence, the operator may, as is occasionally done, omit a special injection for the buccinator nerve and trust to this diffusion, hoping that the resulting pain will not be so severe as to cause complaint during the operation.

The third method, that is, injection into the inflamed tissue, to anesthetize the buccinator nerve, is obviously open to serious objection.

This paper deals with the fourth method, considering the anatomy and technic of establishing anesthesia in the area supplied by the buccinator nerve, by employment of a nerve block technic.

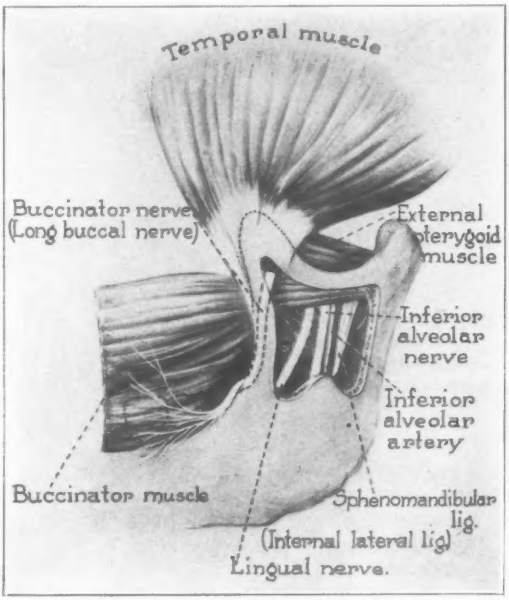

Fig. 1.—Position of buccinator nerve and selected structures on medial side of ramus of mandible. (From dissections made by author.)

ANATOMY

A description of the course of the buccinator nerve taken from Morris' "Human Anatomy" follows. This was selected because, while it is more complete and accurate than most, it is fairly

typical, and it suggests that the nerve may have a relation to the temporal muscle. (Figs. 1-3.)

The buccinator (long buccal) nerve, entirely sensory, passes between the two heads of the external pterygoid muscle and runs downward and forward under cover of or through the anterior fibers of the temporalis to the cheek. As it passes forward it emerges from under cover of the anterior border masseter and lies on the superficial surface of the buccinator, where it interlaces with the buccal branches of the facial nerve and gives off filaments to supply the suprajacent skin; finally it pierces the buccinator and supplies the mucous membrane on its inner surface as far forward as the angle of the mouth. The fibers of the anterior deep temporal nerve, a branch of the masticator, frequently are associated with the buccinator until the latter passes between the heads of the external pterygoid; then the anterior deep temporal nerve separates from the buccinator and passes upwards on the lateral surface of the upper head of the pterygoid.

The following description of the course and relations of this nerve is based on 120 dissections. In each of these dissections, I looked for but did not find variations of its course within the temporal muscle. In addition, I have not seen any evidence on cadavers that the buccinator nerve "usually" assists in the enervation of the lower premolar and first molar teeth. The description differs materially from those in all standard textbooks on anatomy or anesthesia consulted.

Fig. 2.—Relation of buccinator nerve to temporalis and its sheath, and mandible. (From dissection made by author.)

The third, or mandibular, division of the trigeminal nerve, after leaving the cranial cavity through the foramen ovale,

and after giving off a sensory branch to the *dura mater* and a motor branch to the internal pterygoid muscle, branches almost immediately into anterior and posterior trunks. Nearly all of the motor fibers are found in the anterior trunk, whereas nearly all the sensory fibers are found in the posterior trunk. The relatively small number of motor fibers in the posterior trunk pass through the inferior alveolar nerve, leaving that branch near the mandibular foramen to provide motor impulses for the mylohyoid and

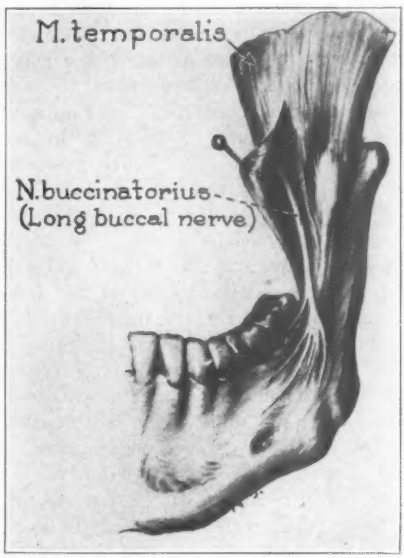

Fig. 3.—Relation of tendon of insertion of temporalis and its sheath to buccinator nerve. (From dissections made by author.) The artist has purposely made the muscle sheath appear much more substantial than it is in the cadaver.

the anterior belly of the digastric muscles. All other fibers in the inferior alveolar and those of the other two branches of the posterior trunk are entirely sensory. The relatively small number of sensory fibers which pass into the anterior trunk constitute the entire buccinator nerve.

The other three branches of the anterior trunk, which are purely motor, are distributed to the remaining muscles of mastication; i.e., the temporal, masseter and external pterygoid. The anterior trunk divides into four branches immediately beneath the foramen ovale and close to the medial surface of the external pterygoid muscle. The buccinator nerve, which is likely to be given off from a stem common to it and the anterior deep temporal (in which event, it may pass over the superior border of the external pterygoid), most frequently passes laterally, downward and forward between the two heads of the external pterygoid, to pierce the sheath of the lower and more tendinous part of the temporal muscle about 40 mm. above the occlusal plane of the lower teeth and about 15 mm. medially to the center of the triangular area which constitutes the coronoid process of the mandible.

The nerve immediately enters the temporal muscle and may be found just beneath the muscle sheath embedded to about level or flush with the surface of this part of the muscle. It now parallels the fasciculi of the muscle, in which it is embedded, and which lie on the medial side of the anterior border of the ramus of the mandible. The principal direction of the nerve in this position is downward, slightly laterally and very slightly forward. Although it usually is nearly 2 mm. in diameter while confined within the substance of the muscle, it is easily confused with the glistening tendinous fibers of the muscle which occur in abundance in this region. The nerve parallels these fibers until it leaves the muscle sheath at the sharp anterior border of the ramus of the mandible at about the occlusal plane of the lower molars.

After piercing the muscle sheath on leaving the *temporalis,* it immediately breaks into a great number of small branches, which spread on the lateral surface of the buccinator muscle and adjacent soft tissues. The nerve may be

exposed from within the oral cavity, and a section of about 30 mm. may be removed in cases of trifacial neuralgia, when such an operation is indicated.

NERVE BLOCK TECHNIC

Injection of the buccinator nerve, with the conduction technic employed in establishing other forms of anesthesia, is relatively simple, safe and effective. Anesthesia is of comparatively long duration, and the likelihood of rupturing a vessel is much less than in other types of nerve block used in oral surgery. The point of the needle may be placed near the nerve or in reasonably close proximity to it, throughout its 40 mm. course within the substance of the temporal muscle, with little or no difficulty.

Two technics are outlined below. However, the operator who becomes familiar with the course of this nerve within the substance of the lower part of the muscle may select any point along this part of the course of the nerve to make the injection.

Technic No. 1.—For ordinary practice, that is, if block anesthesia of this nerve is indicated, the needle may be inserted in the center of the retromolar fossa about 10 mm. above the occlusal plane of the lower molars. The center of the retromolar fossa in this position is about 4 mm. medially to the sharp anterior border of the ramus of the mandible, which marks the lateral boundary of the fossa. The needle is directed backward and slightly outward, piercing in this position the mucous membrane, the buccinator, the thin and nonresisting sheath of the *temporalis* and the muscle fibers of the lower part of the *temporalis.* The needle point is directed gently toward the bone of the fossa and, when the latter is felt, the needle is withdrawn approximately 2 mm., and the desired quantity of the solution discharged.

Technic No. 2.—Occasionally, inflammatory conditions of greater extension in or about the field of operation suggest that it is more desirable to anesthetize the nerve at some little distance from the inflamed area. The operator may then select a point of injection at any place along the course of the nerve in the temporal muscle, with equally satisfactory results. If he chooses to make an injection, which is frequently decidedly desirable, say 24 mm. above the occlusal plane of the lower molar teeth, he should, at the same time, insert the needle from 7 to 9 mm. medially and 3 mm. dorsally to, or behind, the anterior border of the ramus of the mandible. In order to select a point at which to inject, the operator need but remember that from the point at which the nerve emerges from the *temporalis* (at the sharp anterior border of the ramus of the mandible on a level with the occlusal surfaces of the lower posterior teeth), it passes upward, medially and very slightly posteriorly, and that for every 8 mm. of its ascent, it passes 3 mm. medially, and about 1 mm. posteriorly. As it passes upward in the *temporalis,* it departs farther and farther from the surface of the bone, but remains (in the lower four-fifths of its course through the muscle) about 3 mm. from the surface of the overlying oral mucosa.

In giving a detailed description of the terminal (really the beginning) 40 mm. of this nerve within the muscle, I have taken certain liberties. In making the statement that the buccinator nerve pierces the sheath to enter the temporal muscle at approximately the center of the triangular area, which constitutes the coronoid process of the mandible, I take the liberty of assuming that the coronoid process is a triangular area. I have assumed that the coronoid process is that part of the upper anterior part of the ramus of the mandible above a line drawn at right angles to the length of the ramus, which touches on the lowest part of the notch of the mandible. Directional dimensions, that is, upward, medially and posteriorly, are based on

the necessary presumption that the horizontal parallels the anteroposterior axis of the body of the mandible, or, more generally speaking, the horizontal is the plane paralleling the direction of the lower border of the body of the mandible. In embryonic life, the ramus and body of the mandible are not nearly at right angles, but at an obtuse angle to each other. As age advances, the ramus changes its relation to the body until, early in adult life, let us say in the late twenties, the ramus and the body are at approximately right angles to each other, and the anterior border of the ramus has then a silghtly forward inclination (from below upward), owing to the fact that the breadth of the ramus is slightly greater above than below.

As senility is approached, the angle of these two structures (that is, the body of the ramus) becomes less and less acute, until, in the extremely aged, the angle of the ramus with the body becomes decidedly obtuse again. Therefore, the dimensional position given for the buccinator nerve is slightly modified according to age. However, its relation to the forepart of the ramus of the mandible is constant, and for this reason, the operator may assume that the anterior border of the ramus is a vertical line, and then relate the directions of the buccinator nerve as described to this border only. The description of the nerve as "having a 40 mm. course within the substance of the temporal muscle" refers to an adult of approximately 150 pounds, and the length of this part of the nerve is necessarily correspondingly less in smaller people and children.

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344 Fourteenth Street.

SOME RECENT ADVANCES IN THE STUDY OF VIRUSES AND VIRUS DISEASES

By E. W. Schultz,* M.D., Stanford University, Calif.

THE past two decades have witnessed a rapidly growing and widespread interest in a group of infectious agents which in size lie for the most part below the range of the microscope, agents so small that they readily pass the pores of bacteria-tight filters; in some cases, so small that even their living nature has been challenged. Indeed, part of the attraction to the virus field resides in the uncertainty which shrouds the nature of these agents, for if living, they must be among the most primitive forms of life, and if not living, many questions are raised concerning the apparent reproduction which accounts for their serial transmission. A presentation of the problem of the nature of these agents might in itself require the better part of an hour, and is frequently a subject of discourse by those who are invited to speak on viruses.

Read before the Alumni Association, College of Physicians and Surgeons of San Francisco, A School of Dentistry, November 17, 1938.

*Professor of bacteriology and experimental pathology, Stanford University School of Medicine, and professor of bacteriology and pathology, College of Physicians and Surgeons, A School of Dentistry, San Francisco, Calif.

But apart from such fundamental questions as the biologic nature of these agents, there are also many questions of a more practical nature which have intrigued investigators and about which one might talk at some length. Aside from their transmissibility, virus diseases have relatively little in common with bacterial diseases. They tend to differ pathologically, clinically and even epidemiologically from most bacteria diseases. These differences have made necessary new approaches and new lines of thought in the solution of problems relating to infectious diseases. It is my purpose to consider briefly some of these differences and to present certain advances which have been made in our knowledge of several of the diseases caused by these agents.

The story of virus diseases begins with the discovery by Iwanowski, nearly fifty years ago, that the agent of tobacco mosaic disease is small enough to pass the pores of a porcelain filter candle, a finding which went unnoticed for five years until its rediscovery by Beijerinck. This worker, unable to find any organisms in a tobacco mosaic filtrate, described it simply as a "contagious living fluid." It will probably interest you to know that

more than 250 species of plants are now known to be victims of virus diseases, and that the annual losses from such plant diseases run into millions of dollars.

The first animal virus disease was discovered in 1898, quite by accident. While engaged in an attempt to isolate a non-infectious immunizing substance from the lesions of foot-and-mouth disease in cattle, Loeffler and Frosch discovered, much to their surprise, that the infectious agent itself passed the pores of the bacteria-tight candles employed. About the same time, Sanarelli, in South America, discovered the filterability of the agent responsible for a highly contagious disease in rabbits, known as infectious myxomatosis. Since that time, forty years ago, more than a hundred different diseases of plants, animals and man have been recognized as being caused by filter-passing viruses.

Table 1 lists most of these diseases.

It will be noted that the hosts for these agents range all the way from bacteria to man and include various species of plants, insects, fish, rodents, domestic and wild animals, and, finally, man, who is, as you see, the victim of a number of virus diseases. In a few instances, such as in carp pox, herpes zoster and varicella, the filterability of the causal agent has not yet been demonstrated. However, in these particular diseases, the virus nature of the infection has been recognized by histologic and other earmarks which tend to characterize these infections.

Although the so-called viruses differ from bacteria in size, this is no longer considered an outstanding difference. There are indeed some large viruses which are not much, if any, smaller, than the smallest known bacteria. But although a few of these larger viruses fall within the optical range of a good microscope, the vast majority lie definitely below its optical range. The size of many of those which lie below the range of microscopic vision has been measured by means of graded collodion membranes of determined pore size. In Table 2, I have listed the size of a number of these smaller viruses which have been measured by this method. It will be noted that, as a group, they form a tapering wedge, with agents at the top nearly as large as bacteria, and with forms at the lower end which measure approximately 10 μ in diameter, or about one-twentieth the diameter of those at the upper limit. Certain of the plant viruses have been found to fall even below this figure.

We see then that from the standpoint of size, viruses do not constitute a sharply segregated group and that a separation from bacteria on this basis alone is not possible. Much more important are other differences which have been observed between viruses and disease-producing bacteria. Foremost among these is the great dependence of viruses on living cells, a property which is shared by few if any of the bacterial parasites. Thus far, no virus has been cultivated in the absence of living tissue cells. Although a number have been cultivated in the presence of living animal cells in tissue cultures, none have been propagated under artificial conditions in the absence of such cells. This is a basic characteristic which rather sharply sets them apart from bacteria; for although some parasitic bacteria are exacting in their media requirements, the great majority can be grown in the absence of living cells.

Viruses not only depend on living tissue cells, but also are often highly selective in choosing not only their hosts, but also the cells in which they act as parasites within those hosts. Under natural conditions, infantile paralysis virus causes infection in man only. Experimentally, the infection can be transmitted only to certain Old World species of monkeys. New World monkeys, as well as other species of animals, are entirely refractory to it. In both the natural and the experimental disease, the virus limits its attack to nerve cells, causing what seems to be a purely

intraneural infection. In other words, having reached a given neuron, it spreads axonally to reach other neurons and other portions of the nervous system. In this axonal spread, it may seemingly pass through some neurons without causing appreciable damage, even when present in higher concentrations. These cells enjoy a higher level of resistance to the virus, but, in such a migration, it may ultimately reach more vulnerable neurons, such as the motor neurons in the cord and the medulla. Recognition of this axonal mode of spread constitutes one of the most important contributions to our knowledge of the pathogenesis of infantile paralysis, and around this newly discovered fact, much of our reasoning must revolve in studies designed to bring this disease under control.

In infantile paralysis, it is the motor nerve cells in the medulla and cord which are principally singled out. In another neurotropic virus disease, louping ill, the virus singles out the Purkinje cells in the cerebellum. In lymphocytic choriomeningitis, it chooses the choroid plexus and meninges; in yellow fever, the liver cells; in infectious anemia of horses, the blood-forming organs, and so on down through the list of virus diseases. But, although there is this rather striking tendency for a given kind of virus to single out a given species of animal and certain cells within the animal, remarkable capacities for adaptation may also be exhibited. For example, it is now known that yellow fever virus can be transmitted not only to the monkey, but also to the mouse, an animal certainly quite unrelated to man. Human influenza virus can be easily transmitted to ferrets and has been adapted to white mice. The virus of foot-and-mouth disease of cattle can be transmitted experimentally to the guinea-pig. Moreover, certain viscerotropic viruses, such as yellow fever virus, have been rendered neurotropic by serial intracerebral inoculations in certain experimental animals. Other examples of experimental or accidental transmission to hosts quite unrelated to the natural hosts might be cited, but it would be erroneous to conclude that viruses are after all not so very specific, for although a transmission to certain quite unrelated animals is possible, there are usually many species to which infection cannot be transmitted. Sometimes, wide differences in susceptibility are met within a given species. A certain race of white mice have, for example, been found susceptible to a number of viruses to which other races of white mice are quite resistant.

Another exception to the otherwise remarkable specificity exhibited by viruses is the ability of many of them to grow on or in the chorio-allantoic membrane of the developing chick. A number have been propagated in this way, including the viruses of cow pox, epidemic encephalitis and influenza. Although it is not clear why the fetal membranes of the developing chick should provide the nutritional needs for such a large variety of unrelated and otherwise exacting viruses, it would seem that the pabulum offered by less differentiated embryonic tissues is less restricted than that of more differentiated cells. Some viruses resist cultivation on the chorio-allantois of the embryo chick, but can be grown on other embryonic tissue. The virus of rabies, for example, has resisted propagation in the developing egg, but has yielded to cultivation, as has only recently been shown, in tissue cultures consisting of embryo mouse brains in modified Tyrode's solution. Certain viruses are quite particular as to the kind of embryonic tissue that is used. Infantile paralysis virus apparently can be propagated only in the presence of nervous tissue from the human embryo. Nervous tissue from the mature monkey does not provide the pabulum needed, nor does extraneural tissue from the human embryo provide for the needs of this virus.

Associated with the cell specificities mentioned is the tendency of viruses to

actually invade the cells attacked. Although bacterial parasites are largely intercellular parasites and are often not very "choosey" in this respect, viruses are, as far as we know, exclusively intracellular parasites. This intracellular relationship profoundly influences the pathogenesis, the pathologic process, the clinical features, the immunity relationship and even the treatment and prevention of virus diseases. An example of how the pathogenesis may be influenced has already been mentioned in connection with infantile paralysis and the axonal dissemination of this virus.

In virus infections, the finer pathologic process tends to center around a given type of body cell. This may be an epithelial cell, a fibrous connective tissue element or a highly differentiated nerve cell, depending on the specificity of the attacking virus. Although the primary change may be largely overshadowed by secondary inflammatory reactions, it is this initial effect on selected cells which constitutes the central interest in the pathology of a virus disease. The nature of the primary change is influenced by the type of virus infection, by the level of cell resistance, by the virulence of the agent and probably by a number of other factors, but fundamentally the effect produced may range from an outright necrosis of the cell, as in the case of susceptible motor neurons in infantile paralysis, to a stimulation of cell proliferation, as is true in certain virus-induced tumors, such as Shope's rabbit fibroma, Shope's rabbit papilloma and Rous' chicken sarcoma. In some virus diseases, the changes may lie somewhere between these two extremes.

In smallpox, for example, one sees a combination of cell proliferation and so-called ballooning degeneration. In certain virus diseases, the change which may result, although retrograde in character, may not be sufficiently marked to lead to the extinction of all involved cells. Whether the primary change is marked or only mild in character, a secondary inflammatory reaction is apt to follow and is usually of a nonsuppurative type. The inflammatory exudation may be restricted to a slight or moderate grade of perivascular round-cell infiltration, or it may consist of extensive infiltration of the tissue with an exudate containing polymorphic cells as well as round cells.

If we bear in mind that inflammation is simply a response to an injury, and that it may be elicited by a variety of tissue injuries, we can see that it is not necessarily directly related to the presence of the virus, though it is possible that some viruses may by their mere presence elicit an inflammatory reaction. Whatever may be said on this point, present-day investigators of virus diseases are chiefly concerned with the primary effect on the cells singled out by the virus, and not so much with the secondary inflammatory reaction resulting from the primary injury.

It is of interest that in many virus diseases, the infected cells are apt to show intracellular bodies commonly referred to as "inclusion bodies." In some, such as rabies, smallpox and fowl pox, these are present in the cytoplasm of the infected cells; in others, such as herpes simplex, infantile paralysis and Borna's disease of horses, they are present in the nuclei of the infected cells. The intranuclear inclusions are in fact of two types, referred to as type A and type B inclusions. In type A, one sees marked accumulation of acidophilic material in what is normally a basophilic nucleoplasm, associated with a margination and deposition of the basophilic material on the nuclear membrane. This type of nuclear change is observed in herpes simplex and in yellow fever. In type B, the inclusion consists of a spheroidal red droplet in an otherwise normal appearing nucleus. This is the type seen in Borna disease of horses and in infantile paralysis.

Regarding the nature of these inclusion bodies, there has been some difference of opinion, but it is not within the time limit of this paper to present the earlier views, nor the experimental background of our present knowledge. It is now quite generally accepted that the nature of these inclusion bodies probably differs in different virus diseases. In certain infections, such as cow pox, smallpox, fowl pox and molluscum contagiosum, in which large somewhat complex cytoplasmic inclusions occur in the affected epithelial cells, the major part of the inclusion has been found to consist of a myriad of elementary or virus bodies. In rabies, however, in which the cytoplasmic inclusion is often quite as large as in the pox diseases mentioned, experimental evidence indicates that the bulk of the material in the inclusion is derived from the cell itself rather than an aggregation of virus bodies. In the case of intranuclear inclusions also, the material seen probably comes from the nucleoplasm, and though it may contain some virus, it does not consist primarily of virus material.

The intimate relationship between the virus and the tissue cells affected by it probably affords the basis for the solid and lasting immunity which follows virus diseases. As you are aware, most virus diseases are followed by a well-defined and rather long lasting immunity against natural reinfection with the same virus. Acquired immunity of such solidity rarely follows the intercellular infections caused by bacteria and by other intercellular parasites, whether these are of vegetable or of animal nature.

It would seem that virus infections result primarily in some modification of the protoplasm of susceptible cells, a change which may in some way disturb the nutritional pabulum of the cell for the particular virus and render it at least indifferent, if not actually antagonistic, to its presence. A resistant state may possibly also result in part from a replacement of destroyed cells by cells which are more than normally resistant to the particular virus. It seems to be quite the rule that when given cells have been destroyed by an agent, those which are regenerated from surviving cells tend to exhibit a higher tolerance for the same destructive agent. This was demonstrated years ago by McNider for renal epithelium after the administration of uranium nitrate to dogs. We have obtained some evidence that olfactory epithelium in monkeys, after exposure to the destructive action of zinc sulfate, regenerates with a higher level of resistance to this chemical than is exhibited by normal epithelium.

It does not seem unlikely that immunity to other injurious agents, including those of biologic nature, may rest, to some extent, on a replacement of susceptible cells with cells exhibiting a higher level of resistance. On the other hand, we may be sure that this is not always the underlying mechanism, since we know that resistance may be acquired by cells which are not replaced by such a regenerative process, as, for example, acquired immunity on the part of neurons in the central nervous system. Here, certainly, another mechanism underlies the acquirement of resistance, and which to me seems to be more in the nature of a protoplasmic change, directly induced by the virus, which either destroys the acceptability of the cell pabulum for the further propagation of the virus or renders the cell indifferent to its further presence.

You will note that, in these remarks on acquired immunity, I have stressed changes in the protoplasm of normally susceptible cells rather than antibodies in the blood plasma. This brings me to an interesting aspect of acquired immunity to virus diseases, one which may be a little difficult to understand unless we keep clearly in mind certain relationships which exist in virus infections. Although it is true that acquired im-

munity to most virus infections is associated with the presence of antibodies in the blood, it does not necessarily follow that the recovered individual owes much of his resistance to reinfection to the presence of these antibodies.

The degree in which humoral antibodies supplement the acquired tissue resistance probably varies considerably in the different virus diseases, but it seems likely that, in most of these diseases, the rôle played by them is largely secondary. This certainly is the case in poliomyelitis. We have found that, in this disease, even large injections of potent immune serum do not convey to monkeys a significant degree of protection against intranasal inoculation with virus. The majority of the animals so treated not only become infected, but also develop quite as extensive paralysis as is seen in monkeys which have not received immune serum. On the other hand, monkeys which have recovered from the disease sometimes show little or no antibodies in their blood, and yet these animals are fully as resistant to reinoculation as are animals showing a high titer of antibodies in the blood.

The reason for this paradoxical situation apparently rests on the fact that the relatively large antibody aggregates in the plasma cannot pass into the infected neuron and there effect contact with the virus. The inability of humoral antibodies to prevent infection in the first place seems to rest on the fact that the first neuron in the chain can be reached by the virus without having to stem a barrier of immune plasma, since it can reach this first neuron by the free dendritic endings of the olfactory nerve, lying unguarded outside the body in the vault of the nose. Once having penetrated this easily accessible portal, the virus may continue freely on its way from one neuron to another through the brain and brain stem down to the highly susceptible motor nerve cells in the medulla and cord, all along the way out of reach of humoral antibodies. Only as far as it may venture out of these neurons or is exposed by the disintegration of the neurons is it likely to be reached by the immune plasma.

You may ask, if this is true, why are these antibodies produced and where? I think it is clear that they are not produced simply because they may play a rôle in the defense against reinfection, but rather because it is a law of the animal body to respond to foreign substances and because the virus of infantile paralysis is an effective antigen and, like certain other foreign substances, including some nonpathogenic agents, such as the bacteriophage, is capable of eliciting an active humoral response. The antibodies which are formed against this virus are probably not produced at all by the cells specifically parasitized; namely, the nerve cells, but rather by another widely distributed system of cells, the reticulo-endothelial system. It seems likely therefore that antibody production in such virus diseases as infantile paralysis is purely the result of the contact of the virus with this antibody-producing mechanism of the body. The response is therefore purely adventitious and secondary to the more basic changes which occur in the protoplasm of the cells susceptible to the action of the virus.

What I have related regarding the secondary rôle played by humoral antibodies influences rather profoundly what one can accomplish in the way of artificial immunization against infantile paralysis and probably other virus diseases. It is much easier to elicit a humoral response on the injection of inactivated virus antigens than to induce the more basic immunity changes in the protoplasm of normally susceptible cells. Apparently, the only way the latter can be effectively induced is to cause living virus to come in intimate contact with normally susceptible cells; in other words, to induce an infection of these cells. For this reason, the ideal agents for active

immunization against virus diseases are living, attenuated virus suspensions, such as can be fully trusted not to produce the "full blown" disease. We have such a vaccine in cow-pox virus, an extremely effective preventive against smallpox. Other than this, however, we are still largely limited to the use of chemically inactivated viruses, the immunizing value of which is generally relatively inferior. Any immunity response elicited by such inactivated viruses, used as vaccines, is therefore likely to be largely or entirely humoral in nature, rather than basically cellular in type. Unless the nature of a particular virus infection is such that the virus must stem an immune plasma to reach the cells which it elects to attack, such vaccines are not apt to prove effective in controlling the disease.

We see then how essential a thorough knowledge of the pathogenesis and immunologic relationships in a given disease are to an understanding of the problem relating to its control. In the case of infantile paralysis, such information has not only served to explain why attempts at passive and active immunization have failed, but has also made clear that entirely new lines of attack will have to be devised if this disease is to be conquered. Out of this need have grown the recent studies designed to elicit a chemical means of modifying the portal of entry for this virus as a means of controlling the disease. But although virus diseases have certain features in common, the problem of controlling each individual disease will have to be solved along lines best suited to its peculiar weak points. In certain ones, it may be by means of vaccines; in others, by chemical means, and in still others, by as yet entirely undiscovered means.

At this point in my paper, I was forced to decide whether to proceed with a consideration of the other properties exhibited by these peculiar agents of the disease, such as their resistance to physical and chemical agents, their electrical charge and the degree in which they yield to purely physical and chemical manipulation, concluding with a consideration of their biologic nature, or instead to proceed with a brief review of what has been learned regarding a few of the diseases caused by these agents. Though I was greatly tempted to do the former, I decided to take the latter course and say something about the recent advances which have been made in our knowledge of the common cold, of influenza and of herpes simplex, three diseases with which you as dentists have some contact. I wish also to say a little about the rôle of viruses in the etiology of certain tumors. I shall begin with the common cold.

THE COMMON COLD

Although the term "common cold" has a somewhat varied meaning and on that basis a varied etiology, the primary cause of the true epidemic form of common cold has recently been established to be a filterable virus. Dochez and his associates in 1929 succeeded in inducing the typical disease in human volunteers and in chimpanzees with bacteria-free filtrates of nasal washings from acute cases. The conclusions of these investigations are supported by the fact that the typical clinical syndrome could be induced only in man and chimpanzees and not in common laboratory animals. The virus can be propagated in tissue cultures, and infection can still be induced after a number of serial transfers to such living media. Experimental observations by Dochez offer support to the commonly recognized fact that acquired immunity to reinfection by the common cold virus is of comparatively short duration. This makes the "common cold" one of the few exceptions to the general rule that acquired immunity in virus diseases tends to be lasting; an unfortunate exception when one considers the aggregate of human suffering and economic losses caused by this

relatively benign affliction of mankind. This is especially true if we consider the frequent occurrence of such complications as paranasal sinus infections, laryngitis and tracheitis, which, by the way, are chiefly the result of secondary infection by pyogenic bacteria. It is important to note that secondary invasion by bacterial pathogens is a rather common phenomenon in virus diseases, and it is for this reason that different pathogenic bacteria are commonly associated with common colds and have been held to be the primary cause. Although these secondary invaders undoubtedly aggravate and prolong the disease, they probably are not frequently the primary incitant of this affliction. It is for this reason that the so-called "common cold vaccines," consisting of mixtures of various pyogenic bacteria, killed by heat or chemicals, have no scientific basis. The scientific application of a common cold vaccine would naturally call for the incorporation of the primary agent, the virus. Such vaccines are not yet available.

INFLUENZA

Of more interest are the recent contributions to our knowledge of influenza. I am glad of the opportunity to present these because (1) the subject is one which is of concern and interest to everybody, and (2) it affords a fine example of the steps and methods by which our knowledge of virus diseases has been advanced during recent years. To me, the development of our knowledge of influenza is one of the most fascinating chapters in modern medicine. And I am sure that to you who brave all that is propelled from the mouths of men, this story will be of some interest. Parenthetically, I have wondered why the dentist with all his genius for invention has not yet devised a mask which will protect him against all that is belched forth from the caverns over which he works daily, but I am not here today to make you self-conscious.

I shall pass over the earlier investigations on the etiology of influenza, of which there were many, with the statement that these centered almost entirely around bacterial agents. The organism which drew the greatest attention was a small gram-negative bacterium first isolated from influenza patients by Pfeiffer in 1892, and which, because it requires certain accessory growth substances present in blood, was later named *Haemophilus influenzae*. Until the great pandemic of 1918-1919, during the World War, this organism was quite generally regarded as the cause of influenza. However, studies carried on during this outbreak revealed that although it was present in the lung lesions of some cases, sometimes in pure culture, other cases yielded pure cultures of hemolytic streptococci. This suggested that the primary agent had not yet been unearthed and that the bacterial forms recovered from the lesions were probably in the nature of secondary invaders. About this time, some positive evidence was also obtained that the agent was probably in reality a filter-passing virus, but since the results of these experiments, which were carried out on human volunteers, were not uniform, investigations the world over came to a close at the end of the epidemic with the etiology still unsettled. Many, however, came to entertain the belief that the disease was actually caused by a filter-passing virus, and this was the status of the influenza problem until about five years ago.

An interesting development grew out of the fact that during the last great pandemic in 1918-1919, a new disease appeared in swine in this country, a disease which, in its high infectivity, symptomatology and pathology, was so much like human influenza that the conclusion was inescapable that the two diseases were of similar etiology. Although this disease was first recognized

in 1918, it was not until 1931 that its exact etiology began to be unraveled. We owe this contribution to a brilliant young investigator, Richard E. Shope, working in the Division of Animal Pathology of the Rockefeller Institute for Medical Research at Princeton, N. J. Dr. Shope made the surprising discovery that the disease, in its more typical form, is not caused by a single agent, but by the combined action of a filter-passing virus and a bacterium answering to the description of the influenza bacillus, to which he gave the name *Haemophilus influenzae suis*. The use of neither agent alone produced the typical disease, but their inoculation together produced an experimental disease which was in every respect similar to the natural disease in swine. However, of the two agents, the virus proved the more important. When the bacillus was inoculated alone, no detectable illness resulted and immunity did not follow; whereas use of the virus alone produced a mild, transient illness, from which the animal recovered with an immunity against the severe natural disease. With this as an introduction, I turn now to the human disease.

As I have already indicated, some observations had been made during the 1918-1919 pandemic which suggested that human influenza might be caused by a filter-passing virus rather than by the organism described by Pfeiffer. Shope's observations naturally had the effect of adding fuel to a smoldering interest in the virus hypothesis. All that was needed was an epidemic of human influenza to furnish a source for the suspected virus. Such an opportunity came in the form of a small epidemic in England in the beginning of 1933. Immediately after its appearance, Andrewes, Laidlaw and Smith, of the National Institute for Medical Research in London, undertook to inoculate all the commonly used species of laboratory animals with filtered nose and throat washings from influenza patients, with the result that "none of the animals turned a hair." Some one then suggested the use of the ferret, probably because this animal had previously proved highly susceptible to the virus of dog distemper. Accordingly, two ferrets were inoculated intranasally with the filtrates of nasal washings. Nothing happened for forty-eight hours, then both animals began to show signs of illness, which developed into the clinical features of an influenzal attack. There was a sharp rise of temperature, followed by a rapid decline and in turn by a secondary rise with a more gradual decline. There were lassitude, muscular weakness and loss of appetite, a nasal discharge, watering of the eyes and nasal obstruction. Pathologically, the nasal mucosa showed acute inflammation and loss of ciliated epithelium.

The successful transmission of influenza to ferrets naturally opened the way for an extensive investigation of human influenza, which has been carried on not only in England, but also in America. I can touch on only some of the main developments.

Soon after the British investigators showed that human influenza virus can be transmitted to ferrets, Shope found these animals to be highly susceptible to the swine influenza virus also. Indeed, only minor differences have been observed in the properties of the human and the swine strains, such as may possibly be fully accounted for on the basis of an adaptation to the respective hosts. However, although the natural disease in swine has been demonstrated to be of complex etiology, requiring both the virus and the bacterium *(Haemophilus influenzae)* for its full development, the disease in ferrets appears to be caused solely by the virus. Although in ferrets the disease is ordinarily limited to the upper respiratory passages, it was found that when the virus is administered to anesthetized ferrets, the infection, in-

stead of being limited to the upper respiratory passages, extends to the lungs and there causes a plum colored area of consolidation. It is, therefore, possible to induce in ferrets either the mild disease with only upper respiratory involvement or the more severe disease with pulmonary involvement. It has also been found that the influenza virus can be adapted to white mice, and that, in these animals, the lesions tend to have a pulmonary, rather than upper respiratory localization. Furthermore, in mice, infection is not spread by cage contact as in ferrets. For this reason, white mice have come to be used extensively in experimental work, since elaborate precautions to guard against natural infection are not necessary. White mice, especially a certain strain of white mice (Swiss strain), have been found susceptible to a number of different viruses, including epidemic encephalitis (type B), rabies and yellow fever, and are being used by the tens of thousands in various virus investigations.

If it seems strange to you that a virus so highly adapted to man should be transmissible only to ferrets and to mice, it will probably surprise you still more to learn that it can also be propagated on the chorio-allantoic membrane of the developing chick. Fertile eggs at about the tenth day of incubation are used. By a technic devised by Burnet in Australia, the chorio-allantoic membrane is caused to separate and fall away from the shell membrane and to form an artificial air sac parallel with the long axis of the egg. The virus filtrate is introduced through a small opening and inoculated on the upper surface of the membrane at the floor of the new air chamber. Virus so propagated in the initial passages multiplies without causing any recognizable lesions in the membrane. On further serial passage, small white plaques, or lesions, are formed and, with a still fuller adaptation, the virus actually invades and kills the embryo itself. This method of propagating virus, which, as I stated earlier, has been used widely in the propagation of other viruses, may eventually serve as a means of propagating the influenza virus for use in the preparation of vaccines against this disease. In addition to the egg method, the virus has also been propagated in ordinary tissue cultures prepared with embryonic tissues and a medium suitable for the growth of animal cells.

Since the original isolation of the virus by the British group in 1933, it has been recovered from influenza patients by different investigators all over the world. What is of especial interest and practical significance is the fact that all these strains have been found to be either antigenically identical or closely related to each other. This in itself lends considerable support to the fact that the virus originally isolated actually represented the causal agent of this disease. It can apparently be recovered from patients only during the first few days of illness. Filtered washings taken later in the disease are innocuous to ferrets, as are also washings from patients suffering with the common cold.

NEUTRALIZING ANTIBODIES

Earlier in my paper, I dwelt on the neutralizing antibodies which make their appearance in the blood during and following most virus diseases. Such antibodies are also demonstrable in the blood following recovery from influenza and considerable interest has centered around the question as to how long these remain and in what measure they are related to the acquired resistance that follows recovery. In ferrets and mice, antibodies appear in the blood soon after the induction of infection and continue to increase during convalescence. They tend to persist for at least several months after recovery.

Of particular interest are some of the serum studies which have been carried on with samples of the normal human

TABLE 1.—DISEASES CAUSED BY FILTER-PASSING VIRUSES

Host	Disease
Turkish tobacco	Mosaic disease
Other plants, more than 250 species	Mosaic "yellows," "streak diseases," "rosette," etc.
Bacteria	Bacteriophagy
Honey bee	Sac-brood
Lepidoptera	Jaundice of silkworms Polyhedral disease
Fish	Carp pox (?) Epithelioma of barbus (?) Lymphocystic disease (?)
Fowls	Encephalomyelitis Fowl paralysis (?) Fowl plague Fowl pox Leukemia, Newcastle disease Rous sarcoma
Parrots and parakeets	Psittacosis
Canaries	Canary pox
Blackbirds	Plague of blackbirds
Mice	Infectious ectromelia Theiler's mouse virus
Rats	Novy rat disease Pyogenic virus
Guinea-pigs	Epizootic hepato-enteritis Guinea-pig epizootic Guinea-pig paralysis Guinea-pig plague Submaxillary gland disease
Rabbits	Infectious myxomatosis Shope fibroma Shope papilloma Virus III infection
Dogs	Carpano virus infection Distemper Infectious anemia Rabies
Fox	Distemper Encephalitis
Swine	Hog cholera Swine pox Swine influenza
Sheep	Catarrhal fever (blue tongue) Louping ill Naerobi disease Rift Valley fever Sheep pox
Cattle	Acute encephalitis Cattle plague, cattle warts Cow pox Foot-and-mouth disease Pseudorabies (mad itch) Stomatitis papulosa
Horses	African horse sickness Borna disease Equine encephalomyelitis Equine influenza Horse pox Infectious anemia Vesicular stomatitis
Man	Acute anterior poliomyelitis Alastrim Australian X disease Common cold Dengue Epidemic encephalitis A (?) Epidemic encephalitis B Herpes simplex Herpes zoster (?) Influenza Inclusion blennorrhea Japanese encephalitis Lymphocytic choriomeningitis Lymphogranuloma inguinale Measles Molluscum contagiosum Mumps Papilloma of the larynx Pappataci fever Smallpox Swimming pool conjunctivitis Trachoma (?) Varicella (?) Verruca (warts) Virus B Yellow fever (Also rabies, psittacosis, equine encephalomyelitis, etc., transmitted from lower animals)

population. These have revealed that from 70 to 100 per cent of the normal adult groups in our population may show neutralizing antibodies for influenza virus, although only a small fraction of children have them. Observations such as these tend to contradict a rather common belief that immunity to influenza, like that to the common cold, is relatively short lived. As has recently been pointed out, this impression may rest in part on the fact that what is sometimes regarded as successive attacks of true influenza may be a series of clinically similar diseases having a different etiology. Francis has obtained serologic evidence that this fact is partially responsible for the impression. The clinical nature of influenza is such as to frequently make an accurate diagnosis extremely difficult. In addition, the impression that immunity to influenza is not lasting may rest in part on the recently discovered fact that although different strains of influenza virus are for the most part indistinguishable antigenically, they do differ at times sufficiently that an individual may not be left with a well-defined acquired resistance to other strains. There are no doubt other factors in the duration of

TABLE 2.—SIZES OF SOME ANIMAL VIRUSES BASED ON ELFORD'S GRADACOL MEMBRANES

Virus	Size Microns	Investigator
Psittacosis	200-300	Levinthal (1935); Lazarus et al. (1937)
Vaccinia	125-175	Elford and Andrewes (1932)
Lymphogranuloma inguinale	125-175	Mitjagawa et al. (1935); Broom and Findlay (1935)
Herpes simplex	100-150	Elford, Perdrau and Smith (1933)
Infective ectromelia	100-150	Barnard and Elford (1931)
Rabies (fixed virus)	100-150	Galloway and Elford (1936)
Rous sarcoma	100	Elford and Andrewes (1935)
Equine encephalomyelitis (Russian strain No. 2)	85-130	Lazarus and Howitt (1937)
Borna disease	85-125	Elford and Galloway (1933)
Vesicular stomatitis	70-100	Bauer and Cox (1935); Galloway and Elford (1933)
Fowl plague	60-90	Elford and Todd (1933)
Rift Valley fever	23-35	Broom and Findlay (1933)
St. Louis encephalitis	20-30	Bauer, Fite and Webster (1934) Elford and Perdrau (1935)
Equine encephalitis	20-30	Bauer, Cox and Olitsky (1935)
Yellow fever	15-27	Findlay and Broom (1933)
Louping ill	15-20	Elford and Galloway (1933)
Poliomyelitis	12-17	Theiler and Bauer (1934) Elford, Galloway and Perdrau (1935)
Foot-and-mouth disease	8-12	Galloway and Elford (1931)

the resistant state. At any rate, the results of recent studies do seem to contradict, to some extent at least, the general impression that acquired resistance to influenza tends to be short lived.

I am sure that every one is interested in the question as to what extent acquired resistance to this disease can be assured by artificial means. This question, I am happy to say, has already received some attention. As I stated earlier, infection with this virus was induced experimentally in animals by instilling the virus intranasally. This is usually the only way that it can be induced. It is therefore only logical to inquire into the effect which may be produced by injecting the virus by some other route, such as the subcutaneous. May such a measure lead to an increased resistance to intranasal inoculation? The answer thus far seems to be at least partially in the affirmative. In ferrets, several such injections result in the appearance of antibodies in the blood and eventually in a partial resistance to intranasal inoculations with virus. Complete resistance has not been produced, but, in both ferrets and mice, the tendency to develop pneumonia is greatly reduced by such immunization. Convalescent ferrets, which have partially lost their resistance, may be made again immune by such a course.

If the results described for animals hold for man, the practical gains which may be predicted from experimental work thus far are twofold: (1) a probable reduction of the incidence of influenzal pneumonia among those persons who enjoy no residual immunity whatever and (2) an increased, possibly even complete immunity, in those persons who already possess a partial immunity and require only a stimulus to develop it to its full strength. Certainly any measure which will serve to reduce the incidence of influenzal pneumonia will prove a help in combating this disease, since it is the complicating pneumonia which is the chief cause of death. The mortality from influenza during pandemic periods is often very high. Stubbs and Bligh, in their book entitled "Sixty Centuries of Health and Physick" (1931), in referring to deaths from influenza during the last pandemic, say: "In the seven countries of Europe alone in 1918-1919 there died one million four hundred and forty thousand and of those mainly persons of robust health and youth. If the six million deaths in India be added, the total toll exceeds all those killed in the whole four years of the Great War. Over three thousand died in London in one week in October, 1918." It has been estimated that in the United States, this pandemic attacked about a fourth of the population and caused approximately 55,000 deaths. Such figures impress us with the importance of this disease, for which each generation of mankind offers fresh fuel. It tends to recur in pandemic form about every thirty years, each major outbreak being preceded and also followed by lesser waves. If this rule continues to hold, we may now begin to look for the next pandemic. It is for this reason that we welcome the rapid advances which are being made in our understanding of this disease.

HERPES SIMPLEX

Herpes simplex, a relatively mild affliction with which dentists probably have some contact, is a localized eruptive disease of the skin and mucous membranes, characterized by the appearance of clusters of small vesicles resting on a mildly inflamed base. The eruption is frequently heralded by an itching, prickling or burning sensation. The lesions appear commonly on the skin around the mouth, lips and nostrils, and on the mucous membranes of the mouth and nasopharynx, though they may appear elsewhere on the body, including other mucous surfaces. The skin lesions usually dry up in the course of a few days with the formation of yellowish crusts,

which drop off in a short time and leave a brownish red discoloration. The vesicles which appear on mucous membranes usually give way rapidly to superficial ulcers with a red tender base which generally heal within a week or ten days. Sometimes the infection may be transplanted to the cornea of the eye and there cause a severe and serious keratitis.

Herpes simplex is frequently associated with such infections as lobar pneumonia, cerebrospinal meningitis and typhoid; hence the name herpes febrilis. It may, however, also be associated with a variety of other disturbances, including gastrointestinal upsets and focal infections in the mouth and with menstruation, etc. It has been seen to follow the administration of vaccines and drugs.

The infectious nature of herpes was first demonstrated by Grüter in 1913. He succeeded in transmitting a herpetic keratitis of man to the cornea of rabbits. Seven years later, Doerr and Vöchting discovered that herpetic keratitis so induced in rabbits may at times be followed by invasion of the nervous system and an acute encephalitis, and that the virus can be readily transmitted from rabbit to rabbit by intracranial inoculation. About the same time, Levaditi, in Paris, demonstrated the filterable nature of the agent.

It seems probable that this virus is rather widespread and exists in the mouths of many people as a source of latent infection, becoming active in the presence of some disturbance which serves to pave the way for this active manifestation, such as febrile diseases, focal infections, menstrual disturbances and foreign protein injections. The virus has been demonstrated in the saliva of normal persons, and one wonders in what cells it is propagated in the absence of lesions, and just why certain disturbances in the health awaken it to activity. In most cases, active infections seem to be autogenous, but epidemics of herpes simplex are known to have occurred. A few investigators believe that a certain type of epidemic encephalitis (type A) may possibly be caused by the presence of certain highly neurotropic strains of herpetic virus.

CONCLUSION

I shall conclude with a brief review of recent contributions to our knowledge of the rôle played by filter-passing viruses in the etiology of tumors. In 1911, Peyton Rous, of the Rockefeller Institute, discovered in chickens the existence of certain sarcomatous tumors which are transmissible to new hosts by cell-free filtrates of the tumor tissue. Indeed, several different types of sarcoma were recognized, filtrates of each producing each particular type of tumor. For example, the virus of one produced a characteristic type of soft sarcoma while the virus of another produced nodules presenting the structure of an osteochondrosarcoma. Later, Begg discovered a virus inoculation of which constantly induces an endothelioma in chicken and another which induced a tumor presenting the characters of a fibrosarcoma. A great deal of interest has centered around these tumors in chickens and much has been written about them. Closely related to these tumors are certain leukemias in chickens which are transmissible by cell-free filtrates.

Virus-induced tumors have also been discovered in mammals. A few years ago, Dr. Shope discovered in the cottontail rabbit a fibroma which can usually be transmitted by subcutaneous injection of cell-free filtrates of ground tumor suspensions. This benign tumor, incidentally, bears an interesting immunologic relationship to the highly fatal infectious myxomatosis of rabbits in that it affords protection against the highly fatal myxoma disease; also in that it has been found possible to transform the benign fibroma virus into a malignant myxoma virus.

The virus tumors that I have mentioned thus far are all of connective tissue origin. Virus tumors of epithelial structure also occur. About the time that Shope discovered the fibroma in rabbits, he also discovered a papilloma occurring in the cottontail rabbit. In this case, the infection can be induced by rubbing the filtrate into a small scarified area of the skin. The growth which develops is superficial, but may reach enormous size. The serum of papilloma-infected rabbits shows neutralizing substances for the virus, and it is possible by intraperitoneal injections of the virus to protect rabbits against experimental cutaneous infection. As the name indicates, this is a benign tumor, but Rous has found that carcinomatous changes associated with metastasis to regional lymph nodes and lungs may arise in these tumors.

The benign papilloma in man known as the common wart was shown years ago to be caused by a filterable virus. There is evidence also that condylomata acuminata and laryngeal papillomata are caused by the presence of a filterable virus, probably the same virus that is responsible for common warts. It seems entirely possible that papillomata occurring in other organs, such as the bladder, intestine and ovary, may also be caused by filter-passing viruses.

To what extent other tumors of animals and man are caused by virus infections, an interesting question, is considered by Peyton Rous in a recent issue of the *American Journal of Cancer* (1936).

ETHICS, THE SOUL OF DENTISTRY (I)

By J. Wright Beach, D.D.S., Buffalo, N. Y.

ETHICS is the rich, pure food of our profession. It carries nourishment to every fiber of its historic structure, creating, through its beneficent influence, the spirit of time's most revered and sacred usages anchored upon the imperishable foundation of the Golden Rule.

With a background approaching a century of modern ethical interpretation, we have built up accepted standards of deportment and procedure richly justifying the confidence of the public, which has been our generous reward; and we have but to point with reverential pride to that great host of our profession's forebears whose strict adherence to these vital tenets have, through sacrifice and travail, elevated our calling to its present high plane of a scientific health service.

Without undue bias, we trust, let us place dentistry in its correlative position as a member of the health, moral, social and economic structure of the civilized world of today. Standing guard at the "portal of infection" through which a high percentage of pathogenic organisms enter the body; restoring and preserving means for the mastication of food; replacing artificial supplies for lost teeth, we literally provide essentials without which the glow of health and the smile of beauty could not exist.

Let us not underrate our status as a world power, neither magnify ethical values beyond practical needs and present-day demands; and while the story

of ethics forms a fascinating chapter in the development of human relations toward the higher plane of behavior, the threads of its woven fabric may be retraced through the earliest records of savage tribes who deemed it unlawful to steal from or wrong a fellow tribesman, but highly commendable to commit depredations against those of another tribe.

Not until the Socratean period, however, was ethics made the subject of special consideration, with the underlying principles grouped and correlated into comprehensive relationship. Socrates, born 470 B.C., laid the foundation of the science of ethics and his logic lighted the flame of knowledge that illumined the pathway of justice through succeeding centuries; and it was Cicero who said, "Socrates brought down philosophy from the heavens to the earth. . . . His martyr death put the seal to his philosophy, inaugurating the most splendid period of intellectual greatness which the world has yet seen—the philosophic age of Plato and Aristophanes." Socrates was the first to proclaim that "the proper study of mankind is man; human nature, human duties and human happiness make up a field of really urgent and profitable inquiry."

Xenophanes said that Socrates continued incessantly discussing human affairs, investigating—What is piety? What is impiety? What is the honorable, the base? What is the just, the unjust? Men that knew these matters, he accounted good and honorable; men that were ignorant of them, he assimilated to slaves.

"Socrates was distinguished mainly by his theory of virtue. Virtues, he said, consisted in knowledge. To do right was only the road to happiness, and, as every man sought to be happy, vice could arise only from ignorance or mistakes as to the means; hence, the proper corrective was an enlarged teaching of the consequences of actions."

Upon this statement rests the foundation rock of ethics, where succeeding generations have erected the superstructure of human relations which regulate and govern equitable actions of men throughout the realm of civilization.

Then followed Plato, born in 429 B.C., who became an ardent student of Socrates and further developed and expanded the principles of his master, becoming the profound reasoner and wise teacher of his time.

It remained for Aristotle, born in 384 B.C., to complete the trinity of Greek scholars whose treatment of ethics has been accepted by moderns as fundamentally embracing and theoretically sound.

This early concept of ethics still casts its lengthened shadow across the achievements of our earnest pioneers and brings into relief mental pictures of great men who blazed the highway that they were forced to travel.

Without this adamantine wall separating us from the empiric, might we not be forced to contemplate the replacement of our time-honored precepts with legal statutes of political construction, opening the way for lowered standards of practice and, mayhap, eventuating in the dreaded realization of the socialized servitude of our profession under machine domination?

333 Linwood Avenue.

EPOCHS IN DENTISTRY

By A. W. Chance, D.D.S., M.D., Portland, Ore.

An epoch is defined as any event or time or an event marking the beginning of a relatively new development.

Several times during the last century, epochs have been marked in the progress of dentistry. As responses to public demand, they have been associated with social, economic or health conditions, or have been marked by the labors of farsighted members of the profession themselves.

I wish to speak more particularly concerning an epoch just now beginning which, it seems to me, offers the greatest opportunity to dentists and dentistry in the hundred years of its growth, and which, if properly understood and employed, will advance it further in public esteem and have greater returns than any movement up to this time.

The epoch of just ninety-nine years ago was marked by the establishment in Baltimore of the first dental school in the world. By some, and in some respects, this was regarded as a catastrophe and was considered to be the result of a blind spot in education, for it split dentistry off from the major stem of medical education and practice and separated the oral cavity, containing the teeth and their investing tissues and associated parts, from the rest of the human body.

The effect of this was, until more or less recently, that the dentist did not have the broad educational foundation of the general practitioner of medicine and surgery, or of any of their minor specialties, and the physician and surgeon has known but little of the teeth and mouth. While some practitioners of the specialties have allowed themselves to deteriorate into mere technicians, neglecting their general medical information, many dentists, making no effort to broaden their knowledge of the fundamentals of medicine and surgery, have done no more than repair teeth that were decayed or broken, and replace them when lost, with artificial substitutes. Until the prevention of caries is better understood, its control must be largely mechanical. However, we, as dentists, must concern ourselves with broader aspects of practice than mechanics alone. We must be able, through other knowledge, to fulfil our responsibility in general public health. Certain influences are at work now to bring this about. Of these also, we must have full knowledge, if we are to determine its destiny.

Read at the Pacific Coast Dental Conference, Vancouver, B. C., July 8, 1938.

THE CAST INLAY

Just before the turn of the century, an epoch was marked by a revolution of much of the operative and prosthetic dental technic employed. I refer to the outstanding work of Taggart in the application of the casting process to dentistry. This made practice physically easier for both the patient and the operator. Unfortunately, even such an outstanding useful process had some injurious effects in the hands of unthinking and careless practitioners. Some gave up entirely the use of cohesive gold. Some adopted one piece castings, promulgated by laboratory technicians, which are contrary to all physiologic principles.

FOCAL INFECTION

An outstanding epoch in the practice of dentistry was marked nearly twenty-five years ago as a result of the experiments, and their publication, by Rosenow and others, on the constitutional effects of infection of the teeth, and there were as a result wholesale extractions, at times upon the sole orders of physicians and without justification.

As a result, throughout the world, and especially in the United States, where the practice was more prevalent, many persons were made dental cripples. Exodontists were created by the hundreds and thousands to meet the demand for extraction of teeth, the oral surgeon rose overnight and the full denture prosthetist came into being.

However, the wave of extracting did damage in some instances in addition to wrecking the masticating apparatus; for today we see advertisements in the daily press which seem to indicate that dental practice is confined to the manufacture of artificial teeth. This attitude is, unfortunately, not confined to the advertiser alone. We know of many who advise the extraction of useful teeth or who destroy them by unscientific partial replacements.

The World War marked an epoch in dentistry. Army and Navy authorities were shown the need for dental corps to help safeguard the health of officers and men alike, and now practically all armies and navies have fully manned dental corps. In the American Army, the head of the dental corps ranks as a brigadier general by recent congressional enactment.

There are certain schools and private practitioners who recognize the importance of a broader view of the place dentistry should occupy in a health program. These are not satisfied with the glib use of the expression "dentistry is a health service," but are actually engaged in making it so.

THE EDUCATIONAL SURVEY

In the educational field, under a grant from the Carnegie Corporation of New York, an extended survey of the curricula of American dental schools was undertaken. This survey took several years and cost several hundred thousand dollars. A report of 400 pages was published in 1935 and is available to all.

A paragraph from this report reads:

Many oral diseases, disorders, and deficiencies are directly related to systemic health; either they may be the result of systemic disturbances [example: hyperparathyroidism causing periodontitis, i.e., pyorrhea], or they may cause diseases in other parts of the body. [Example: focal infection causing arthritis, endocarditis from mouth infection.] Well informed dentists realize this fact; they take into account the general health of their patients as they render dental service, and they call upon physicians for assistance in the care of certain types of cases. Among the important services dentists perform for their patients is the detection of the early signs of systemic disease, and advice regarding the need for medical service. Progressive physicians likewise appreciate the relations between oral and systemic health and they call upon dentists for cooperation in the diagnosis and treatment of diseases in which oral conditions are factors. These considerations make it apparent that the dentist should have an understanding of the principles of medicine.

From the course of study by dental students as set forth and recommended in the report, the statement is made:

As a result of this study of such a course the student should be able:

(1) To understand the clinical application of principles and facts learned in the basic sciences.

(2) To recognize the importance of cooperation between dentists and physicians in rendering health service and to be competent to take a proper part in such cooperation.

(3) To understand the general procedures employed by a physician in making a diagnosis.

(4) To recognize the presence of oral manifestations of systemic disease.

(5) To comprehend the relationship be-

tween oral infection and systemic disease.

(6) To recognize the symptoms of systemic disease which might influence the plan of dental treatment.

(7) To read medical literature more intelligently.

(8) To participate intelligently in public health work.

(9) To appreciate bedside consultations and hospital procedures and routine.

This definitely marks an epoch in dentistry. I call attention to the fact that this report and these statements are made in connection with the course of study in dental schools and, when the effect of such changes is shown in the knowledge possessed by graduates of those schools which are introducing such courses in their curricula, a dentist will be qualified to cooperate with physicians in a health service that will be of unquestioned value to the individual patient and to his community.

MEDICAL-DENTAL EDUCATION

We hear frequently that physicians should know more of dentistry. The catastrophe of the separation of dentistry from medicine is in process of being corrected in medical schools as well as in dental schools.

At Yale, through a grant of $250,000 from the Harkness Foundation, there was established in the medical school a department of oral surgery. This has been operating for nearly ten years, under the direction of a dentist, who is an instructor to the medical students during their entire four years of medical training.

In other universities, close connection between medical and dental education exists throughout the full course of study.

Dentists have been on the staffs of hospitals for many years, but until more recently have been under the direction and control of the medical staff. They have been called upon largely for the extraction of teeth which have been designated by the physician.

At the University of Oregon Medical School, since 1930, there has been a division of dental medicine consisting of a staff of fourteen dentists and one resident. The dental resident is on the same basis as all other interns and residents in the hospitals connected with the medical school. The head of the division, a dentist, is an associate professor in the medical school and each year delivers a course of lectures to medical students. He or a member of the staff is in consultation with the medical and surgical staffs in the hospitals daily, but in no respect is under their direction. These activities show the way to a broadening of the horizon of dentistry and add to its possibilities as a health service. This marks an epoch in medical and dental education which in turn is marking an epoch in dental practice.

In 1933, the State of Oregon passed a law which, upon appeal, finally reached the Supreme Court of the United States. In 1935, the Chief Justice, Mr. Hughes, handed down an opinion which forever placed dentistry in a position to regulate the conduct of its members. This opinion was based upon the statement that dentistry as a profession is concerned with the public welfare and health, and this certainly marked another epoch in the recognition of dentistry in connection with public health.

There are now eight states which have dental members on boards of health. In Oregon, a dentist is president of the board. In the United States Public Health Service, there are forty-eight dentists regularly commissioned. They rank with the medical officers and are stationed throughout the United States and in foreign countries.

Yet many dentists are content to limit their service to the mechanics of repair and replacement. The time is approaching when such dentists will find themselves unable to further retard the inevitable progress of dentistry and must fit themselves, as are the young men re-

cently graduating from the advanced schools of dentistry, to meet greater responsibilities in the practice of their profession.

Since the passage of the Social Security Act, great extension of public health dentistry has taken place. Surely this constitutes another epoch in the progress and prestige of dental practice. In fact, this promises to be the greatest step forward that dentistry has ever taken in public recognition. It has been made so suddenly and is so new to dentists that most of us are not yet aware of its import, or of its extent.

If it is not to get out of hand, however, and finally result in that bugbear of the professions, state medicine and state dentistry, it is absolutely necessary that dentists familiarize themselves with the movement and its great significance, in order to guide its progress so that it may remain under proper control.

Some of us are familiar with the American Public Health Association, embracing in its membership public health workers of Canada and the United States, including physicians and dentists. Recently, in Portland, a three-day meeting of the Western Division of the American Public Health Association was held, drawing an attendance of nearly 500 from eight states and the western provinces of Canada. The next year's president is a dentist, Guy S. Millberry. On the Sunday preceding that meeting, the entire day was spent in a discussion of public health dentistry. This discussion was participated in by the regional director of the Children's Bureau of the United States Department of Labor; the regional supervisor of the United States Public Health Service; the director of dental health education of the Berkeley Public Schools; the state health officer of Oregon; the director of the Oral Division of the Oregon State Board of Health, and medical and dental health authorities from California, Washington, Idaho, Nevada, British Columbia and Alberta. Its chairman was the president of the Oregon State Board of Health, a dentist.

DENTISTRY IN THE ARMY

Many of you are familiar with the program adopted by the Surgeon General of the United States Public Health Service for the control of venereal disease, and I am sure you will be interested in the statement which the regional director of the United States Public Health Service made at this meeting: "The program of the United States Public Health Service for the control of syphilis, as well as of smallpox, typhoid, tuberculosis and all communicable diseases, in my opinion is not, nor are any or all of them, as important as the control of dental disease." It seems that this statement should put dentists on the alert to participate in public health as applied to dentistry. C. E. Waller, who is Assistant Surgeon General of the United States Public Health Service, commenting on the effect of the depression, beginning in 1929, upon public health activities, said that many of the state, provincial and federal activities were greatly decreased and that, upon the passage of the Social Security Act in the United States and the release of federal funds for the promotion of public health, their first objective was the restoration of the personnel existing before the depression. Since that time, the extension of health service, rendered by federal and state authorities, has been greatly increased so that now in the United States there are thirty-five states with definite dental programs as part of their public health activities. Many of these have full time personnel. On the Pacific Coast, the states of California, Oregon, Washington, Nevada and Utah have full-time dentists in the employ of their state health boards.

SOCIAL SECURITY

In the Social Security Act of the United States, which provides funds for maternal and child health, no actual

mention is made of dentistry; and yet, with the cooperation of the United States Public Health Service and of the Children's Bureau of the Department of Labor of the United States, dentistry has become a part of the maternal and child welfare program. Some of the new dental programs are operated as divisions of the maternal and child health programs. Some states, previous to the passage of the Social Security Act, had dental programs, either under the direction of state health authorities or as a part of education of the state school systems. Most of these have been brought into cooperation with the federal program under maternal and child health. As of October 15, 1937, the total expenditure of federal funds in one year on dental programs has reached the sum of $390,500. Much of this has been spent for educational work.

The total sum available annually for health programs in the United States under the direction of the Federal Government is between eight and eleven million dollars. Much of the program, both medical and dental, is of an educational character, designed for the prevention of disease, not for its cure or correction. This is primarily the purpose of the dental programs throughout the various states. As the result of this, through the education of the laity by various means, the interest of parents and public school teachers in dental care is promoted. The effect of this is to bring into private practices children formerly not patients. Wherever these programs have been in existence (and they have been in some states for nearly twenty years), the dentists who have cooperated have been enthusiastic over this type of education for prevention of dental disease. As a result, the dentists themselves have experienced a great increase in the volume of their practices, with greatly increased financial returns.

Under the Social Security Act also, provision is made for educating both physicians and dentists in public health, and through the cooperation of the Federal Government with state boards of health, many physicians and dentists have been sent to universities and schools offering courses in public health. In the state of Oregon, we have sent fifteen men to Harvard, the universities of California and Michigan and several other universities.

We are permitted under the Social Security Act to pay all expenses of the physician or dentist during such a course of training, including traveling expenses and, under certain conditions, salaries. The courses in public health must conform to the requirements of the United States Public Health Service. For those states and for those dentists in states that have not yet adopted dental programs as a part of public health work, such funds are available, but must be disbursed by state boards of health.

I urge the members of the dental profession to familiarize themselves with public health dentistry in order that our profession may take its place in public health programs, to be under the direction of dentists themselves as far as present regulations permit.

1025 Medical-Dental Building.

FULL DENTURE CONSTRUCTION

By Frank L. Hart, D.D.S., San Francisco, Calif.

THE statement can be made, without challenge, that dentistry's crowning achievement is the successful restoration of the lost dentition by mechanical means.

The basic fundamentals involved are the same as those governing any other restorative operation. Success will result only when proper correlation has been attained and tissue compatibility has been established between the artificial substitute and the remaining natural structures. Many dental disturbances which are later encountered result from ignorance of this fact, whether the prosthesis was an inlay or a full set of artificial dentures.

The technical procedure by which artificial dentures are made is not original with any one man, but represents the efforts of many men. Outstanding have been the works of Bonwell, Snow, Gysi, Williams, Supplee, Tench, Stansbery and others too numerous to mention.

The motivating impulse responsible for the formation of the Northern California Prosthetic Group was the united desire to correlate the efforts of these men into a technical procedure based upon accepted fundamentals that it would be practical for the average dentist interested in denture prosthesis to follow.

Successful artificial denture construction depends primarily on the accuracy of the operative procedure of determining centric position. In order to determine centric position, an understanding of what constitutes centric position is required. Centric position is that position of the mandible in its relation to the maxillae wherein both condyles are in a comfortable retruded position in their respective fossae, from which functional movements can be made. In this position, the muscles of mastication attached to the mandible are capable of exerting their maximum crushing force.

To accomplish this, the osteologic parts must be correctly positioned and the forces exerted by the functional muscles employed during mastication be accurately balanced. To balance these muscular forces, it is necessary to locate the focusing point of greatest muscular exertion of the muscles of mastication attached to the mandible.

This point is located somewhere on a plane equidistant between the ridges on the median line and in the region of the first permanent molars. To locate this point, centric relationship plates have to be used. By their use, this point can be located and the mandible can be correlated to the maxillae both anatomically and physiologically. More dentures fail because of not being in centric position anatomically and physiologically than for all other reasons combined. It is the least understood requirement of denture construction.

The centric relationship plates about which this technic has been built are designed to secure muscular balance. There has been incorporated within their construction an adjustment by which it is possible to locate the focusing point of greatest muscular exertion. This adjustment consists of a central bearing or balancing stud that is attached to the upper plate. This stud is capable of being moved anteriorly or posteriorly until muscular balance has been obtained.

The complete correlating apparatus (Fig. 1) consists of two metal plates one of which contains a center stud capable of being moved in two directions, a tracing pin, a recording platform and an articulator mounting tongue necessary for mounting the casts upon an articulator. This apparatus, when correctly used, will register both anatomic and physiologic centric positions, record the lateral and protrusive movements, determine the

A. The occlusal plane.
B. The position of the upper central incisors.
C. The approximate intermaxillary opening.
D. The position of the centric relationship plates upon their respective bite rims.

The final registration determines:

A. The true intermaxillary opening.
B. The true centric position.

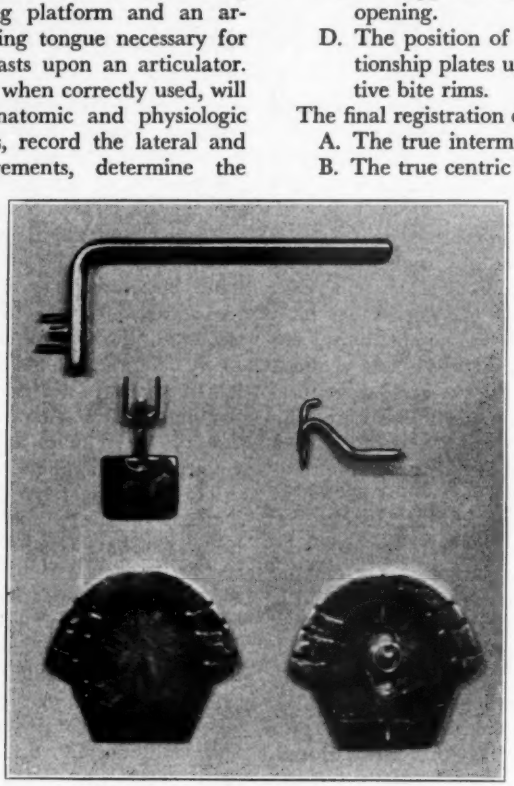

Fig. 1.—Centric recording apparatus.

cuspal height and assist in mounting the casts upon an adaptable articulator.

CENTRIC RELATIONSHIP

The operative procedure for securing anatomic and physiologic centric relationship is divided into two phases, the registration of a preliminary centric relationship using wax bite-rims, to be followed by a final registration using the centric relationship plates.

The preliminary registration determines:

C. The mandibular movements.
D. The position of the casts upon the articulator.

To successfully perform the operation of registering centric relationship, some understanding of the functional mechanics of the human jaws is required. The mandible is an approximate equilateral triangle, first recognized as such by Bonwill, the apices being located at the heads of both condyles and the symphysis. If legs were added to this triangle, a three-legged stool would result.

As long as the legs of such a mechanical contrivance remain intact, it is impossible to so place it that it will not balance.

Visualize the mandible as an inverted stool, the heads of the condyles as two of the legs, and the teeth, when properly occluded, the third leg. As long as the teeth function on a plane that is in harmony with mandibular movement resulting from muscular exertion, balance is maintained. This plane of tooth function is known as the functional curve, or

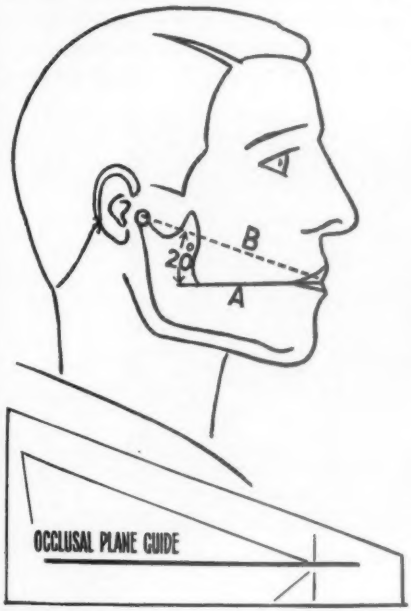

Fig. 2.—Theoretic occlusal plane.

curve of Spee, and is individual to all cases. Remove the teeth and you have lost the third leg of the stool. Success can result only when the lost teeth have again been restored mechanically to function in harmony with mandibular movement produced by muscular exertion and to maintain muscular balance.

The use of the central bearing stud is a mechanical restoration of the lost third leg of the stool. If properly placed, it offers no interference to natural mandibular motion. It functions on a plane that is placed in the median line of muscular force. If this plane is the same as the occlusal plane of the lost natural teeth, any mandibular motion that is the result of muscular exertion will be fundamentally the same as that produced when the natural teeth were present in the mouth. As mandibular movement starts away from centric position, it can easily be seen that if the patient is instructed to perform the three major functional mandibular movements, namely, protrusive, right and left lateral, the starting point of movement would be centric position.

This leads to the belief that the most important step in securing centric position is to determine the lost occlusal plane. Study has shown that this plane geometrically is situated at a 20 degree angle from lines drawn from the heads of the condyles to the incisal edges, at the median line, of the lower central teeth. (Fig. 2.) To determine this plane, a simple guide has been devised (Fig. 2) which permits drawing this plane on the sides of the face. The upper bite-rim is trimmed to parallel these lines, to be at right angles to the long axis of the face and to possess sufficient length to be level with the upper lip line, mechanically restoring the lost occlusal plane.

The lower bite-rim is trimmed to conform to the occlusal surface of the upper bite-rim and possess sufficient height to restore mechanically the required intermaxillary opening. The median line is scribed upon both bite-rims, with sufficient lateral inscriptions, the purpose of which is to allow correlation of the wax rims later in the laboratory. This simple operative procedure completes the taking of the preliminary centric registration. When mounted on an articulator, its principal use is to attach the centric relationship plates upon their respective bite-rims. (Fig. 3.)

The laboratory procedure to accomplish this is as follows:

On mounting the casts upon an articulator, the height of the lower bite-rim is removed or reduced equally at least three-sixteenths inch. The peripheral edge of the lower recording plate (one without the stud) is heated sufficiently that when it is placed upon the lower wax rim, it will adhere to it. Care must be taken that it parallel the upper unreduced rim when the articulator is closed. The median line mark that is engraved upon the surface of the plate must coincide with the scribed median line on the bite-rim and the scribed mark on the rear of the plate spaced equidistant between the ridges of the lower model.

To attach the upper recording plate to its respective rim, the same amount of wax is removed from its occlusal surface. The plate is heated and positioned upon the reduced rim. Care must be taken that it is parallel to the surface of the one attached to the lower rim when the articulator is closed; that the median line marks scribed upon the plates coincide, and that the rear mark is placed equidistant between the ridges of the upper model. The balancing stud is adjusted to be in contact with the surface of the lower plate when the articulator is closed and is placed tentatively two-thirds distally in the slot.

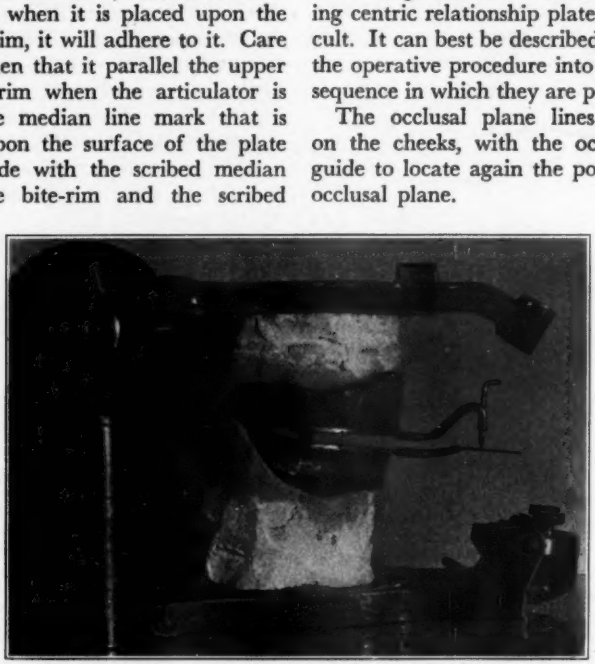

Fig. 3.—Bite-rims with recording apparatus attached.

REGISTRATION OF CENTRIC POSITION

The registration of centric position using centric relationship plates is not difficult. It can best be described by dividing the operative procedure into steps, in the sequence in which they are performed.

The occlusal plane lines are drawn on the cheeks, with the occlusal plane guide to locate again the position of the occlusal plane.

The upper bite-rim with the attached plate is placed in the mouth. Its occlusal surface should be parallel to these facial lines, and at right angles to the long axis of the face and the median line as indicated in the desired position.

The lower bite-rim with its attached plate is placed in the mouth. Its occlusal surface must parallel that of the upper plate. The median lines that are engraved upon both plates must coincide. Sufficient space should exist between the plates to allow for motion free from interference. Corrective adjustments are

made if necessary by repositioning the lower plate.

With both plates in position, the lower being lightly stabilized with the fingers, the patient is instructed to protrude, retrude and laterally move the mandible a number of times, exerting while doing so slight muscular pressure. This procedure educates the patient to perform these movements and centers the relator plates.

With the mandible in approximate centric position, the patient is instructed to exert considerable muscular pressure. If there should be noted any anterior-posterior tipping of the lower plate due to this pressure, muscular balance does not exist. The stud is then adjusted either forward or backward, as the case may be, until balance is obtained. If there should be any lateral tipping due to this pressure, the stud is not in the median line of muscular force. Correction is made by repositioning the upper plate.

Proper intermaxillary opening is determined. A change is made when necessary by increasing or decreasing the length of the central bearing stud.

The case is now ready to be traced and this is done in the following manner. The surface area of the lower plate upon which the stud rests with carbon protected is coated with a thin layer of carding wax. The tracing platform is also coated and attached to the lower plate. The tracing pin is attached to the upper plate. The lower plate is returned to the mouth and the patient is instructed to close until contact is felt on the stud. While manually stabilizing the lower plate, the patient is instructed to protrude and then retrude the mandible. This movement is scribed upon the tracing platform by slight pressure on the tracing pin. From the position of retrusion as shown on the tracing platform, first the right and then the left lateral movements are scribed. If these movements are recorded properly, there will have been engraved on the tracing platform an obtuse angle bisected by the protrusive tracing. The point of this bisection is the anatomic centric position. To preserve this relationship, impression plaster is injected into the space between the plates and allowed to set.

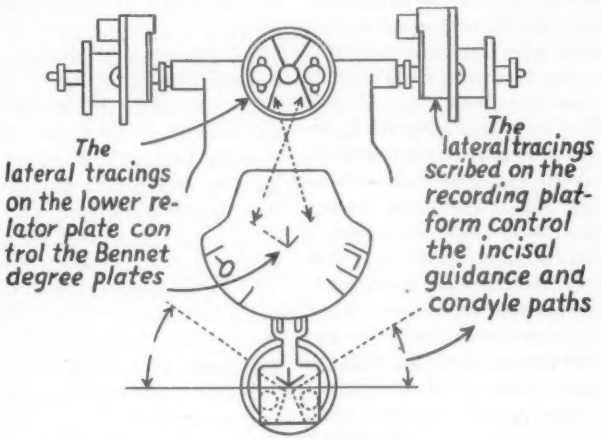
The lateral tracings on the lower relator plate control the Bennet degree plates
The lateral tracings scribed on the recording platform control the incisal guidance and condyle paths

Fig. 4.—Articulator adjustments.

The tracing pin and recording platform are now removed and the facebow tongue is attached to the upper plate. A

facebow (Snow or Hanau) is adjusted to this tongue, recording by its aid the correct altitude of the Bonwill triangle and the anterior posterior relationship of the jaws to the heads of the condyles. The use of a facebow is now recognized as a necessity whenever a hinge axis articulator is used. It is almost impossible to correctly adjust such an articulator if the casts are not properly mounted.

INTERPRETATION OF THE RECORDINGS AND TRANSFER TO THE ARTICULATOR

Articulator movements are the reverse of jaw movements. The right lateral movement of the articulator is the left mandibular and the protrusive movement a retrusive one when mechanically duplicated by the instrument. Theoretically, they are the same, but if this physical difference is not recognized, articulation difficulties may be encountered. The fact that the upper articulator bow is movable instead of the lower creates an illusion and this must be recognized.

The lateral tracings (Fig. 4.) that were etched on the tracing platform are records of mandibular movement. They represent the approximate angulation and paths taken by the heads of the condyles in a functional motion. The angles of variance of these lateral tracings, when determined from a horizontal line scribed with a straight edge at the apex of the gothic arch, are the degrees of inclination upward or downward for the paths that the heads of the condyles will follow when moving out of centric position.

These angles, on being determined with a protractor, become the angles of inclination or settings for the sagittal condylar degree plates. (Fig. 4.) These lateral tracings (Gysi) are also segments of circles. Their centers are the centers of mandibular rotation. The degree plates that control variance in the centers of rotation are set on the incisal table to duplicate these angles.

The Bennett movement, which must be considered, represents the outward motion of the heads of the condyles that occurs in conjunction with lateral movements of the mandible. It is recorded on the wax that was placed on the lower relator plate, in the area where the stabilizing stud attached to the upper plate rested on the lower. To reproduce this movement on the articulator, the upper bow is manipulated, first in one lateral direction and then in the other, the Bennett degree plate being readjusted, until the stud attached to the upper plate follows the same paths that it scribed in the wax on the lower plate when in the mouth.

The cuspal height or accurate movement is a measurement of vital importance. It governs the vertical distance between the jaws during lateral motion and determines the amount of overbite and overjet of the upper central incisors. From a practical standpoint, this height may be determined by placing the stud attached to the upper plate at the point of extreme protrusion, as etched in the wax upon the lower recording plate. The incisal guide table is freed, the stud being permitted to rest firmly on the lower plate, and the degrees of angulation from zero are noted. This reading will be on the negative side of the gage and when reversed (15 degrees negative from zero considered as 15 degrees positive) will provide a satisfactory setting for the incisal guide table.

SETTING AND BALANCING THE TEETH

The laboratory procedure of setting up and balancing teeth is fairly well understood. Little has been added since Professor Gysi's research on articulation was given to the profession. The fundamentals then advanced have stood the test of time. However, slight changes in procedure have to be made to fit this technic.

The bite-rims having been altered to fit the inter-occlusal plates, the plane of occlusion is situated equidistant between

them. This plane should be followed as nearly as possible, the operator setting up the entire upper case with the lower relator plate acting as a guide.

The lower teeth are set one side at a time, the first molar first, the second bicuspid and then the first bicuspid teeth. It should be borne in mind that opposing forces result in the formation of a curve, representing the path of least resistance, or what is referred to as the curve of Spee. This curve is produced by balancing each tooth individually, readjusting the opposing upper teeth until an occlusal arc is formed that is harmonious with functional motion. This curve will vary, often being excessive on one side and shallow on the other, as the different shapes of arches and condylar inclinations influence it. This curve is individual to each case and is the arc of functional movement.

The incisors are set next, followed by the second molars. The second molars should not be overarticulated. Persistent distolingual soreness will invariably result as the functional arc is shorter and muscular pressure greatest on these teeth.

The lower cuspids are articulated last, with readjustment when necessary of the occlusal edges, so that they will act as lateral guides to occlusion, a function intended to be theirs by nature. The entire set up is check balanced, waxed and contoured for the final trying in.

After the curing process, all excess material is trimmed from around the teeth, and the cases are left intact upon the models on which they were cured. The cases are remounted in their respective plaster matrices on the articulator bows and attached securely with sticky wax. The purpose of this is to correct any occlusal discrepancy that may have been caused in curing.

In finishing, all peripheral margins are rolled and polished, especially the posterior palatal border on the upper and the throat form flanges on the lower. The inside surfaces are polished as nearly as possible to the same degree as the outside, all irregularities that might cause irritation being removed. This polishing will increase the comfort of the cases and produce adhesion between the supporting tissues and the dentures.

The object in developing this technic has been the desire to produce artificial dentures physiologically compatible with their supporting structures, restoring to a marked degree lost function and lasting in their comfort to the prospective wearer.

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L. PIERCE ANTHONY, D.D.S., Editor

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MARCH *Editorial Department* 1939

EDUCATING THE PUBLIC DENTALLY

FROM its very origin as an organized profession, dentistry has been handicapped from lack of knowledge on the part of the public as to the relation and importance of dental health service in the maintenance of the health of the body as a whole.

Dentistry is still faced with the desirability of educating the public as to the rôle of the profession in maintaining the health of the nation; yet, at the same time, is bound around with a professional heritage of ultra-ethical restrictions that have prevented the profession as a whole, as well as the individual member, from any activity, method or scheme that has for its purpose the publicizing of the benefits which dentistry can render to humanity. Any thought or suggestion of publicity which has savored of the modern methods of advertising has been frowned upon as unethical and beneath the dignity of the profession.

As the years have passed, we have realized that this attitude of mind has been a distinct influence in retarding the benefits of health service in all its phases and has encouraged and frequently compelled certain classes of the public to obtain their information on dental health subjects from questionable sources.

In the early days of our existence as a profession, the extent to which the individual vaunted his skill and his manner of doing placed a stigma upon publicity methods that it has required heroic means to overcome. These first misguided efforts toward publicity resulted in a decided revulsion against publicity or anything that even suggests the advertising methods of early days, and it seems that the heritage of aversion to anything that savors of advertising has been so indelibly imprinted upon the soul of dentistry that a strong inhibitory influence has developed against the legitimate and ethical methods of disseminating information concerning dentistry—an attitude toward publicity which has prevailed to such an extent throughout the years that the public appreciates little of the purposes and aims of dental practice, to say nothing of its important ancillary relation to medicine as a safeguard to general bodily health.

Spasmodically, throughout the past several decades, groups of dentists have realized the seriousness of the handicap we have unwittingly placed upon ourselves and have advanced means, methods and plans for overcoming it; but our hereditary fear of the evil consequences of advertising has, in almost every instance, prevented acceptance of any particular plan.

Several years ago, a carefully conceived plan of dental publicity was inaugurated by a well-intentioned group in the profession, but the unfortunate labeling of the venture as advertising resulted in the premature death of the movement. The unfavorable reaction to this effort was immediate, and as it was so apparently directed toward professional advertising, we were almost convinced at the time that if the word "publicity" had been used instead of "advertising," the plan would have been approved and successfully applied, to the distinct benefit of dentistry.

More recently, numerous localized efforts have been inaugurated, with the aim of educating the public to a proper appreciation of dentistry as a health service, and while some have borne fruit, most of them have suffered from half-hearted or indifferent support. Probably the most effective educational efforts were those which involved instruction in the care of the mouth in the public schools of the country. The sum total of these efforts, however, proved quite as educational to the dentist as to the public, in that, in an effort to prove to the public the advantages of dentistry to school children, the profession was awakened to a realization of the desirability of hygiene of the mouth as a disease preventive measure. And thus was born the theory and doctrine of oral hygiene.

In our first efforts at publicity through the public press, the manner of pursuit brought doubtful results. One of the handicaps under which we labor in attracting attention to dentistry through the press is the fact that dental practice does not lend itself to the sensational or spectacular as do some of the incidents of surgery and medicine. In some instances, the character of the newspaper publicity has been to the discredit of dentistry rather than to its credit.

The doubtful value of the publicity received in general was the impelling cause for the adoption of an organized method of publicity directed through the agency of the American Dental Association. Such an agency, the Bureau of Public Relations, was established in 1931, and has since functioned as a definite activity of the American Dental Association. As the scope of the work of the Bureau has enlarged, some two years ago the Bureau included in its activities a campaign of educational publicity through the newspapers, which has been eminently successful in directing and determining the character of publicity and has been particularly salutary in establishing a cooperative and wholesome attitude on the part of newspapers toward dentistry.

More recently still, and supplementing the activities of the Bureau of Public Relations, there has been established in Greater New York the Greater New York Bureau for Dental Information. This body, which represents practically all of the interests of organized dentistry in Greater New York, has for its purpose the dissemination of authoritative and reliable information on dental subjects to the public through the public press, constituting an intelligently directed cooperative effort toward education of the public in the prevention and care of mouth diseases and the maintenance of a healthy mouth, as well as an endeavor to dispel some of the prejudices that have been unwittingly instilled in the mind of the public toward dental procedures.

We have long realized the benefits that could readily accrue from popular magazine publicity, and a striking example of the service which the Greater New York Bureau for Dental Information can render is illustrated in the publication in a recent issue of *Life* magazine of an article which embodies in a wholesome manner much beneficial information on many phases of dental practice. We wish to take this opportunity to felicitate *Life* on a well-meaning and commendable effort which may well confer incalculable benefit on the public. We also heartily commend the activities of the Greater New York Bureau for Dental Information in the assurance that, conducted by a group of intelligent, high-

minded dentists, with the interests of the public and the profession at heart, it will prove a most helpful supplementary aid to the efforts of the American Dental Association in directing the education of the public dentally.

The present apparent discredit under which medicine and dentistry have fallen in the agitation for socialized medicine may, we believe, be attributed, at least on the part of dentistry, almost entirely to the doubtful value of the publicity we have received and, too, to the lack of organized effort toward educating the public dentally. If the public were thoroughly acquainted with the spirit of the efforts of medicine and dentistry to serve best the health interests of the public, it would not be so ready to follow visionary prophets.

The recent developments in the socio-medical world indicate and demand that an intensive campaign of education among dentists, as well as the laity, be pursued, to the end that the public may be made conversant with the fact that medical and dental health service can best be rendered under the direction of the professions and in the spirit that has guided them to the success which they have already attained.

As to the methods for achieving this aim, those we have mentioned will well serve the purpose for today's generation, but most important of all is the education of the child, not only for his own benefit, but also for the invaluable service he can render in the education of the parent to the benefits of dental health service. This we owe to the coming generation, and such a course will serve as useful and helpful a purpose in their lives as will any plan of socialized health service.

DEATH OF DR. C. N. NEWLIN

Dr. Clarence N. Newlin, Secretary of the Illinois State Dental Society, died at his home in Peoria, Ill., February 12, 1939. An obituary notice of Dr. Newlin will be published in a later issue of THE JOURNAL.

BIBLIOGRAPHICAL

Dental Science and Dental Art

Edited by SAMUEL M. GORDON, Ph.D., National Research Council Fellow (Biological Sciences), 1926-1928; Director, American Dental Association Bureau of Chemistry, and Secretary of the Council on Dental Therapeutics, American Dental Association, 1928-1937. Contributors: B. P. Babkin, M.D., S.Sc.; Allan G. Brodie, M.S., D.D.S.; Theodore Cornbleet, M.D.; H. Trendley Dean, D.D.S.; William M. Gafafer, D.Sc.; Samuel M. Gordon, Ph. D.; Bernhard Gottlieb, M.D.; Thomas G. Hull, Ph.D.; Philip Jay, D.D.S.; Maxwell Karshan, Ph.D.; Harry Lyons, D.D.S.; Sanford M. Moose, D.D.S.; Balint Orban, M.D.; Floyd A. Peyton, D.Sc.; Theodor Rosebury, D.D.S.; Isaac Schour, Ph.D., D.D.S.; Maurice H. Seevers, Ph.D., M.D.; Maurice L. Tainter, M.D.; Edward B. Tuohy, M.D. Octavo, 731 pages, illustrated with 224 engravings. Published, 1938. Philadelphia: Lea and Febiger. Price, cloth, $9.50, net.

In the preface of this book, the editor states that in 1928 he made a survey of dental literature to inform himself on the status of science in dentistry. He writes, "Even a cursory survey showed that a science of dentistry at that time was more in the realm of wishful thinking than an actuality. In the course of several years, much information from the dental, chemical, biologic and cognate literature was collected. . . . Much of this fundamental information was woven into the reports of the Council on Dental Therapeutics, most of which were prepared by the editor. The eagerness of the profession for this type of information makes the editor confident of the need for such a volume. . . . A group of workers, in and out of dentistry, who have made definite contributions in their respective fields, were asked to collaborate by the preparation of chapters on subjects in which they had special knowledge."

Gordon is evidently of the opinion that the material in the book and the point of view are new; that the book will aid in dissemination of the thought that the dentistry of tomorrow cannot rest on mechanics alone, but must rest also on the broad base of science.

A review of the literature of dentistry in the latter part of the nineteenth century is sufficient proof to the reviewer that there was much of science and art in dentistry, as clearly reflected in some of the outstanding texts of that period. We refer particularly to "The American Textbook of Operative Dentistry," edited by E. C. Kirk, 1897, "The American Textbook of Prosthetic Dentistry" edited by C. J. Essig, 1896, and "A Textbook of Operative Dentistry," edited by C. N. Johnson, 1908.

The content of "Dental Science and Dental Art" summarizes in detail some of the most important contributions to the field of dental knowledge in recent years. Schour's section on tooth development and experimental dental histophysiology is a beautiful example of the results of years of study and research by a man well trained in the basic sciences and dentistry.

Brodie's section dealing with the biologic aspects of orthodontia is of particular interest to the general practitioner. There is a detailed study on growth and development of the head, structure and development of the face, the etiology of malocclusion and orthodontic movement of the teeth. The subject is presented from the biologic rather than the mechanical viewpoint. The bibliography appears scanty for such an important subject.

One of the most complete sections in the book is that written by Babkin on the physiology of the salivary glands. It discusses in detail the innervation of the gland and the composition of saliva. There is a noticeable lack of histologic material. The bibliography is extraordinarily well done. It is a great convenience to the dental reader to have a summary of so much work, pub-

lished in so many journals, prepared by an outstanding investigator in this field.

Rosebury's chapter devoted to the problem of dental caries is well written. It is doubtful whether any investigator could write an impartial survey of this question. The content of the chapter is noticeably influenced by the author's experiments dealing with caries in rats. There is a definite lack of histologic studies on human dental caries, and the entire chapter indicates lack of familiarity on the part of the author with the clinical aspects of this problem.

Jay's chapter dealing with the bacteriology and immunology of dental caries is an excellent short review of this subject. The bibliography is well balanced and dissenting views are impartially presented. The major content of the section deals with caries research done under R. W. Bunting's direction at Michigan University.

A short and interesting review of calcium compounds with reference to dental nutrition is Dr. Gordon's contribution to the voluminous text. The bibliography is not comprehensive, but the chapter is well organized and written in a manner easily understood by the practicing dentist. The content of the chapter as the author states it is a modification of a report published in THE JOURNAL in 1936.

One of the most complete and well-balanced chapters in this book is that of Dean on chronic endemic dental fluorosis, commonly called mottling of the enamel, from a clinical and laboratory standpoint. He reviews the literature thoroughly and contributes his own findings. This section will be of practical value to the practitioner and investigator.

The etiology of Vincent's infection by Rosebury and the clinical aspects and therapy of Vincent's infection of the mouth by Lyons are two sections that present a refreshing study of this interesting subject. They well exemplify the application of laboratory research to clinical practice.

A concise summary of material now available in textbook form is presented in Peyton's chapter on restorative materials. This section is well written, contains a comprehensive bibliography and is of real value to the practitioner interested in an introductory discussion of physical properties of restorative materials. S. A.

Practical Pedodontia or Juvenile Operative Dentistry and Public Health Dentistry

By FLOYDE EDDY HOGEBOOM, D.D.S., F.A.C.D. St. Louis: C. V. Mosby Co., 1938. Fourth Edition. Cloth. 371 pages with 312 illustrations. Price $6.50.

Dr. Hogeboom's book recognizes the importance of pedodontia in relation to public health advancement. He attacks the entire health problem from the standpoint of instituting prophylactic measures, keeping admirably abreast of every public health movement in which dentistry is a factor. Promotion of dentistry for children is not a problem for one man, but for all practitioners of dentistry. The book thoroughly covers all phases of pedodontia, from the correction of intractable thumb-sucking habits to the influence of endocrine dysfunction. The book is fully illustrated with excellent color plates, and is a veritable mine of information on dental pediatrics.

A Textbook of General Bacteriology

By EDWIN O. JORDAN, Ph.D. Philadelphia: W. B. Saunders Company, 1938. Cloth. 808 pages with 197 illustrations. Price $6.

Professor Jordan has produced a book which embraces all phases of bacteriology from the medical viewpoint. Although an excellent reference book, it is not so unwieldy as not to be a practical textbook for the student. Those sections which have been rewritten, especially those on oxygen supply and respiration and the virus diseases comprise a complete treatise in these fields. The explanations and descriptions of the various organisms are brief, yet easily understandable and are well illustrated throughout.

A History of Dentistry

By ARTHUR WARD LUFKIN, D.D.S. Philadelphia: Lea & Febiger, 1938. Cloth. 255 pages with 90 engravings. Price $2.75.

The first chapter concerns itself with dental disease as far back as 250,000,000 years ago, when a fishlike animal of the Devonian Seas presented, in fossilized remains, the first evidence of traumatic injury of dental origin. The subject of paleopathology in the various anthropologic classes of men from Pithecanthropus erectus to the modern variety of the species, Homo sapiens, the

evolution of medicine and dentistry during the existence of Sumeria, Babylon and Ancient Egypt and its practice among the Hebrews, Phoenicians and Chinese are thoroughly, yet concisely, treated. The author presents an excellent panorama of medical-dental history in Ancient Rome and Arabia.

The chapter on medieval dentistry is absorbing and is superseded in interest only by that chapter dealing with the advent of dentistry in France. From this period in the sixteenth century, the author colorfully presents the steady progress of medicodental science to the present day. The period of the American Revolution is interesting in every detail, especially the correspondence between George Washington and his dentist, John Greenwood.

The author has appended many valuable and authentic data pertaining to the development of dental education, practice, laws, regulations and requirements in America and the more advanced countries.

The illustrations throughout the book, of caricatures, prints and photographs, are well executed. Each chapter is supplemented with many references.

A Textbook of Bacteriology

By Thurman B. Rice, A.M., M.D. Ed. 2. Philadelphia: W. B. Saunders Company, 1938. Cloth. 563 pages, with 121 illustrations. Price $5.

The author has supplied a long-felt need for a textbook of bacteriology that would eliminate all superfluous material dealing with the subject, elaborating on only the fundamentals. The book lends itself admirably to the needs of dentists, physicians and other professional men. Controversial subjects have been omitted in favor of practical suggestions. To facilitate the comparison of micro-organisms, the author has idealized the drawings, drawing all to the same magnification and showing gram-positive organisms in black and others stippled. The various chapters, dealing with history, morphology, technic, etc., follow in excellent sequence and with clarity. Remote or insignificant details have been omitted, although nothing essentially bacteriologic has been overlooked. The book is extensively applicable to the study of bacteriology in various professional schools.

Books Received

Special or Dental Anatomy and Physiology and Dental Histology, Human and Comparative

A textbook for students, and a ready work of reference for the busy practitioner. In two volumes. By T. W. Widdowson, L.D.S., R.C.S., Eng. Consulting Dental Surgeon to King's College Hospital; Lecturer in Special or Dental Anatomy and Physiology and Dental Histology to King's College, University of London; Member of the Board of Examiners in Dental Surgery of the Royal College of Surgeons, England; Examiner in Special Anatomy for the B.D.S. Degree, University of London; Member of the Board of Studies in Dentistry, University of London; Late External Examiner in Dental Surgery, Dental Pathology and Bacteriology, Dental Anatomy and Physiology and Dental Histology, and Dental Materia Medica to the Liverpool University; Late Contributing Editor to *Oral Health* and to *Dental Practice,* Toronto, Canada; Author of "The Care and Regulation of Children's Teeth"; "Dental Surgery and Pathology," Etc. 564 illustrations and 12 plates. With a special chapter on "Histological Technique" by J. Leslie Young, L.D.S., R.C.S., Eng. Volume II. Comparative Dental Anatomy. Sixth Edition. London: John Bale, Sons & Curnow, Ltd. Price 20/- net.

Manual for Dental Technicians

By J. A. Salzmann, D.D.S., Chairman on Courses for Dental Technicians and Head of Dental Service, New York City Vocational Schools; Editor, *New York Journal of Dentistry;* author of "Principles and Practice of Public Health Dentistry." New York: Pitman Publishing Corporation. Price $4.

Fundamentals of Dentistry in Medicine and Public Health

By John Oppie McCall, D.D.S., F.A.C.D., Director, The Murry and Leonie Guggenheim Dental Clinic, New York City; Consultant in Dentistry, The New York Hospital, New York City. With a foreword by Wilson G. Smillie, M.D., Professor of Public Health and Preventive Medicine, Cornell University, College of Medicine. New York City: The Macmillan Company. 1938. Price $2.75.

COUNCIL ON DENTAL THERAPEUTICS

N.M.P. SOLUBLE—NOT ACCEPTABLE FOR A.D.R.

REPORT OF THE COUNCIL ON DENTAL THERAPEUTICS OF THE AMERICAN DENTAL ASSOCIATION*

IN connection with this report of the Council on Dental Therapeutics, the dental profession should be informed that Neo Merphenol, which is advertised in connection with N.M.P. Soluble, has been examined by the American Medical Association Chemical Laboratory as is shown by the following excerpt from *The Journal of the American Medical Association,* August 31, 1935, page 738:

However, cursory tests recently made in the A.M.A. Chemical Laboratory seemed to indicate that Neo Merphenol contains a substance closely allied to, if not identical with, the organic mercury compound known as Metaphen.

The A.M.A. Chemical Laboratory requested distributors of Neo Merphenol (Lynch and Company) to supply a quantitative statement of the composition, in order that information might be transmitted to inquiring physicians. The firm's attention was also called to the fact that a specimen of Neo Merphenol in the Council's files contained particles of such large dimensions as to render intravenous injection of the product extremely hazardous.

The report of the Council on Dental Therapeutics on N.M.P. Soluble follows:

N.M.P. Soluble, Lynch and Company, Denver, Colo., is a product sold to the dental profession as an effective means of treatment of a wide variety of dental ills, such as Vincent's infection, oral infection, pyorrhea and "all local or oral infections which are open to the surface tissue." According to the advertising circular accompanying the trade package, infections such as acute or chronic cellulitis should be treated with "Neo Merphenol" or "Orthophen" intravenously. The nature of these substances is not disclosed.

The advertising circular gives rather detailed instructions for the use of N.M.P. Soluble in Vincent's infection:

Technic for Treatment of Vincent's Infection:

First sitting:

1. Remove large deposits of calculus and any other irritating factors such as overhanging crowns, etc.

2. Pump N M P Soluble into the interproximal spaces and under the free gum margin with a soft rubber cup. (This requires but a few minutes.) Do not rinse the mouth afterward.

3. PRESCRIBE N M P Soluble for the patient to use at home. Have the patient use it three (3) times a day, moistening the finger tips in N M P Soluble and massage the soft tissues for eight minutes.

Second sitting, following day:

1. Remove all of the remaining calculus and polish the teeth thoroughly.

2. Repeat the pumping of N M P Soluble under the gingiva. Because N M P Soluble is primarily a treatment for the causes of the disease, the appearance of the tissue does not materially improve until most of the bacteria are killed. For this reason after

*Authorized for publication.

three or four treatments improvement in tissue tone is rapid. Have the patient continue home treatment until you are satisfied the case is cleared up. Continue your office treatment each day after the case is clear for as many days as is required to get a negative microscopic finding. This way the disease usually will not return. The N M P Soluble the patient has left is an excellent preventive against new infections and can be used as a mouth wash. If it is used as a regular mouth wash at home it will give constant protection and keep the tissues beautifully toned. This treatment produces quick results without loss of tissue and without discomfort to your patient. Other problems during treatment such as isolation from others of personal things such as drinking cups, silver, etc., are left to your own discretion. If the tooth brush is not discarded it should be constantly in N M P Soluble when not in use to be rendered sterile. (End of Technic)

Evidently the firm is not averse to increasing its sales of N. M. P. Soluble by having the dentist act as a detail man.

Although N. M. P. Soluble is alleged to be a new synthetic organic chemical which "commands the field of oral infection," the firm has not availed itself of the opportunity to submit evidence of the usefulness of this product to the Council. As far as the Council is aware, there is no evidence as to the lack of toxicity of this product, even though the firm states that "there is no danger if it is swallowed." Furthermore, patients are encouraged to swallow the material, as is shown by this excerpt from a testimonial distributed by the firm:

Treatment: Patient was instructed to use N M P Soluble on toothbrush, and to hold quarter to half teaspoonful in the mouth for ten minutes three times daily, and to swallow the same, to reach organism not in the oral cavity.

According to the advertising circular, the technic for treatment of pyorrhea is as follows:

Technic for Treatment of Pyorrhea:

1. Correct tooth brush habits and toilet.
2. Prescribe anti-scorbutic diet.
3. Remove all possible mechanical irritation.

(Calculus, orthodontic trauma, rough tooth surfaces, impinging dental restorations, traumatic occlusions and food impactions.)

4. Polish Teeth thoroughly.
5. Remove epithelium and other abnormal cell structure lining the pockets with a chemical cautery thus leaving a fresh tissue surface.
6. Pump N M P Soluble into the tissue between and around the teeth with a rubber cup. In addition, be sure that the N M P Soluble has reached the bottom of the deep pockets by using the blunt needle technic. (See technic on injecting deep pockets.)
7. PRESCRIBE N M P Soluble for the patient and have it used at home t.i.d. using the same technic in the office as described under treatment of Vincent's infection except more pressure and massage is used.
8. Continue pumping N M P Soluble into the tissue each day until you are satisfied there is no evidence of the disease remaining.

Due to the fact that Pyorrhea tends to return upon neglect of the mouth, have the patient form a habit of using N M P Soluble at least once each day to keep the tissue toned up, and to prevent the return of the disease. Calculus should be removed periodically by the Dentist for best results. (End of Technic)

Apparently, the firm leans heavily on the dentist's skill in the promotion of its product. The question naturally arises: Why use N. M. P. at all? As far as the Council is aware, there is no good answer to this question. Nor does the chemist's report supply a basis for such an answer.

REPORT OF THE BUREAU OF CHEMISTRY

Two original bottles of N. M. P. Soluble (Lynch & Company, Denver) were submitted to analysis.

One bottle contained about 13 cc. and the other about 14 cc. of a yellow fluid with a very slight odor. The label on the bottles bore the following:

N M P Soluble
Bactericidal
Non-Irritating

Absorbs Secretion
Promotes Granulation
Lynch & Co. Denver

Qualitative analysis indicated the presence of ethylene glycol and a mercurated phenol.

Quantitative analysis yielded the following:

Density (D^{30}_4), 1.045
Refractive index N^{24}, 1.423
Per cent solid, 0.2

(End of Chemist's report)

From the foregoing, it may be concluded that N. M. P. Soluble is essentially a solution of a mercurated phenol (0.2 per cent) in ethylene glycol.

Since N. M. P. Soluble is a secret preparation sold with unwarranted therapeutic claims, the Council finds this product not acceptable for A.D.R.

A copy of the rules that govern the Council in the consideration of articles will be sent on request.

HAROLD L. HANSEN, *Secretary.*

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

DENTIFRICES*

Hall's Tooth Paste: Composition: See Sheffield Tooth Paste (A.D.R. 1938, page 117).

Manufactured by the Sheffield Company, New London, Conn. Distributed by the Kauffman-Lattimer Co., Columbus, Ohio. No U. S. patent or trademark.

M & D Tooth Paste: Composition: See Sheffield Tooth Paste (A.D.R. 1938, page 117).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Morris & Dickson Co., Ltd., Shreveport, La. No U. S. patent or trademark.

Sam's Tooth Paste: Composition: See Sheffield Tooth Paste (A.D.R. 1938, page 117).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Sam's Cut Rate, Inc., Detroit, Mich. No U. S. patent or trademark.

Arm and Hammer Brand Sodium Bicarbonate: At the firm's request, Arm and Hammer Brand Sodium Bicarbonate was removed from the list of accepted dentifrices in 1934. Since 1931, this product has been listed, and it is still listed, in Accepted Dental Remedies as a brand of sodium bicarbonate, U.S.P. Upon the firm's decision to again promote their product as a dentifrice, the Council has voted to accept Arm and Hammer Brand Sodium Bicarbonate as a dentifrice for the usual period of one year.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information on the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

ASSOCIATION ACTIVITIES

AMERICAN DENTAL ASSOCIATION

Eighty-First Annual Session
Milwaukee, Wis., July 17-21, 1939

WISCONSIN—THE NATION'S FINEST PLAYGROUND

WISCONSIN—where people come for recreation—to enjoy motoring, fishing, bathing and golf, and to see some of the finest scenery in all the world.

We want you as our guest. Plan a vacation in Wisconsin before or after the American Dental Association meeting. Do this at your earliest possible convenience, so you can obtain all the information necessary.

Mother Nature, man and machine have lavished their efforts to make this the perfect Wonderland in which to work or play, in which to enjoy life to its fullest.

Right here in Wisconsin, you will find a fine climate, a concentration of lakes, innumerable scenic views, excellent accommodations and true hospitality.

Awaiting your enjoyment are thousands of lakes and beautiful streams for short or long canoe trips through virgin forests, two national forests, two Indian reservations, with Indians in their native habitat, two state parks, interesting cities, thriving industries.

Wisconsin boasts of some of the finest highways in the world through beautiful scenic country. Nearly every highway north leads you to Wisconsin's Vacation Land. En route are excellent hotels, trailer camps and tourist camps. There are hundreds of resorts, a selection to suit almost any taste. Numerous information bureaus are scattered throughout Wisconsin's playground to supply information of every kind.

We will go more into detail on these matters as convention time approaches.

F. J. MARTIN, *Chairman,*
Vacation Committee,
Medford, Wis.

Dental Centenary Celebration

BALTIMORE—MARCH 18-20, 1940

MEMBERS of the dental profession throughout the world will be interested to learn that the Dental Centenary Celebration will be held on Monday, Tuesday and Wednesday, March 18, 19 and 20, 1940, at Baltimore, its birthplace. In that city, one hundred years ago (1840), the charter was granted for the first dental college in the world, the Baltimore College of Dental Surgery. Horace Hayden was its first president and Chapin A. Harris its first dean. In the same year, the first national dental organization, the American Society of Dental Surgeons, was formed, with Hayden its president and Harris its secretary. The latter already had begun publication, in Baltimore, of the first dental publication, the *American Journal of Dental Science* (1839).

Appreciating its obligation of fittingly commemorating the founding of the profession and of evaluating the tremendous progress it has made during its first century, the American Dental Association at its last meeting agreed to sponsor the plans for a centennial celebration as proposed by the Maryland State Dental Association. The Board of Trustees and House of Delegates unanimously voted moral and financial support to the project.

After this action, the necessary committees were formed under the general chairmanship of B. Lucien Brun, of Baltimore. These committees, realizing their unique opportunity and the great mass of interesting and valuable material at their command, are leaving no stone unturned to make the centenary one of the most significant events in the onward march of dentistry.

The plans for the celebration have a three-fold purpose:

1. To commemorate the founding of dentistry upon the tripod of education, literature and organization.

2. To depict its evolution through the first hundred years from a mechanical art to a learned profession.

3. To emphasize dentistry's scientific status of the present with its promise for the future.

These purposes will be carried out by pageants and local, national, academic and scientific sessions, as well as by historic, scientific and equipment exhibits.

This preliminary notice is to inform the profession of the place of meeting and date and of the extensive plans now under way. Through following issues of THE JOURNAL and other avenues, detailed information will be made available as the many features of the programs assume more definite form.

EARL W. SWINEHART,
Chairman, Publicity Committee,
Medical Arts Building,
Baltimore, Md.

AMERICAN DENTAL ASSOCIATION MEMBERSHIP

NUMBER OF MEMBERS*	
Alabama	349
Arizona	90
Arkansas	202
Army	209
California	1,499
Colorado	461
Connecticut	866
Delaware	63
District of Columbia	435
Florida	465
Foreign	21
Georgia	432
Hawaii	145
Idaho	106
Illinois	4,037
Indiana	1,086
Iowa	1,082
Kansas	576
Kentucky	546
Louisiana	367
Maine	218
Maryland	401
Massachusetts	1,760
Michigan	1,744
Minnesota	1,656
Mississippi	241
Missouri	1,449
Montana	194
Nebraska	588
Nevada	31
New Hampshire	154
New Jersey	1,942
New Mexico	91
New York	4,787
North Carolina	529
North Dakota	169
Navy	182
Ohio	2,349
Oklahoma	448
Oregon	444
Pennsylvania	3,335
Public Health Service	98
Philippine Islands	0
Puerto Rico	44
Rhode Island	204
South Carolina	180
South Dakota	177
Southern California	1,516
Tennessee	534
Texas	1,067
Utah	235
Vermont	99
Virginia	527
Washington	707
West Virginia	331
Wisconsin	1,512
Wyoming	71
Veterans Administration	115
Panama Canal Zone	15
Total Regular Members	43,179

*As of December 31, 1938.

JUNIOR MEMBERS	
Atlanta Southern Dental College	41
Baylor University	63
Chicago College of Dental Surgery	144
College of Physicians & Surgeons	91
Columbia University	148
Creighton University	12
Georgetown University	99
Harvard University	13
Indiana University	93
Kansas City-Western Dental College	52
Loyola University	118
Marquette University	90
Medical College of Virginia	21
New York University	42
North Pacific College of Oregon	130
Northwestern University	19
Ohio State University	111
St. Louis University	1
State University of Iowa	46
Temple University	80
Texas Dental College	61

Tufts College	2
University of California	23
University of Buffalo	25
University of Detroit	52
University of Illinois	32
University of Louisville	19
University of Michigan	33
University of Minnesota	64
University of Nebraska	4
University of Pennsylvania	6
University of Pittsburgh	2
University of Southern California	155
University of Tennessee	31
Washington University	37
Western Reserve University	104
Total junior members	2,064
Affiliate members	90
Total—All members	45,333

PERCENTAGE†

New Mexico	144.44
Connecticut	144.09
Minnesota	133.55
District of Columbia	133.43
New Jersey	129.55
Utah	114.63
Wisconsin	111.83
Michigan	110.94
North Carolina	107.74
Florida	107.39
Illinois	107.11
Virginia	106.68
Montana	106.01
New Hampshire	105.48
Wyoming	104.41
Tennessee	103.29
Vermont	102.06
Iowa	100.56
Kentucky	100.55
Delaware	98.44
Colorado	96.26
Arizona	95.74
Ohio	95.29
Nebraska	94.84
Missouri	93.30
Indiana	91.72
Pennsylvania	89.68
Mississippi	88.28
Oklahoma	88.19
California	87.21
Southern California	87.21
North Dakota	86.67
Alabama	85.95
Kansas	85.59
Texas	85.29
Rhode Island	85.00
Arkansas	82.79
Washington	82.31
Maine	81.95
South Dakota	81.19
Massachusetts	81.14
Oregon	79.71
West Virginia	78.07
New York	77.85
Maryland	77.26
Nevada	75.61
Louisiana	75.05
Georgia	74.77
South Carolina	73.47
Idaho	69.74

†Percentage of quota obtained by state societies on basis of total membership of 45,000, as of December 31, 1938.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners is in receipt of information that the State Board of Dental Examiners of South Dakota has voted to accept the Certificate of Qualification of the National Board in lieu of its own theoretical examination.

MORTON J. LOEB, *Secretary*,
66 Trumbull St.,
New Haven, Conn.

COMMITTEE ON LEGISLATION

DENTAL PRACTICE ACTS: STATUTORY RESTRICTIONS ON ADVERTISING VALID

THE plaintiffs, licensed dentists, sued to restrain the state board of dental examiners from enforcing certain provisions of the dental practice act relating to advertising. From a judgment denying the injunction, the plaintiffs appealed to the court of civil appeals, Texas, San Antonio.

The act, among other things, defines as unprofessional conduct advertising by a dentist by means of a large display sign or glaring light sign, either electrical or neon, or by signs containing as a part thereof the representation of a tooth, teeth, bridgework, plates of teeth or any portion of the human head, or using specimens of such in display, directing the attention of the public to any person or persons engaged in the practice of dentistry. This prohibition, the plaintiffs contended, was unconstitutional. But, said the court, the power of the state, through its legislature, to regulate and circumscribe the character of advertising by dentists of their professional services, equipment and facilities is now generally recognized and upheld. The power includes the authority to prohibit the character of advertising condemned by the dental practice act of Texas. This power, the court observed, does not rest necessarily on the theory that such advertising must be false or within itself harmful in every case. The true theory is, primarily, at least, that such methods of inducing business are contrary to the well established and universally recognized and respected standard of ethics of an honored and useful profession, the maintenance of which will tend to insure competence in individual practitioners and minimize the influence of the charlatan and quack, who, unable to establish or maintain himself on his own merits and virtues, must and does resort to the tricks and devices denounced by the act.

It may be, the court continued, that purely ethical or esthetic considerations will not of themselves warrant legislative interference in setting up and enforcing standards of professional conduct, although the tendency among the decisions is to hold these considerations to be sufficient. Such considerations, however, are proper elements of public policy behind valid legislative acts of control and regulation; they spring from a presumed opinion and demand on the part of the general public that such methods as those condemned by the act here in question are unseemly and demoralizing and actually in derogation of the general welfare, and should be prohibited. Such acts are upheld on the further ground that they are necessary to protect the weak and gullible from their own incapacity, when suffering from real or imaginary ills, to resist alluring promises of cures, guaranteed or not, and painless or not, at cheaper prices, with better facilities, more skilled treatment, and the like.

There was no merit, the court said, in the plaintiff's contention that the dental practice act offends against the constitutional guaranty of freedom of speech and of the press. The question of freedom of the press was not involved, except as a remote incident of the purpose and effect of the act. The act does not purport to affect the right of the press to publish whatever it sees fit to print, in whatever form or language it chooses. It has been repeatedly and uniformly

held that such legislation is not in contravention of the constitutional guaranty of freedom of speech.

The judgment of the trial court, refusing to enjoin the state board of examiners from enforcing the provisions of the act, was therefore affirmed.—Sherman et al. v. State Board of Dental Examiners (Texas), 116 S. W. (2d) 843. *J.A.M.A.*, 111:469, February 4, 1939.

SUPPLEMENTAL RÉSUMÉ OF THE RESEARCH ACTIVITIES OF ORGANIZED DENTISTRY, LISTING PUBLISHED REPORTS AND PAPERS*

By HOMER C. BROWN, D.D.S., F.A.C.D., Columbus, Ohio

REFERENCE TO PREVIOUS RECOMMENDATION

As a result of the action of the Trustees and the Research Commission of the American Dental Association, I prepared and presented a paper before the Research Section at the St. Paul meeting last year, under the title "A Historical Review of the Research Activities of Organized Dentistry," from which I quote the closing paragraph:

Unfortunately, it is not possible to include a full list of the published reports and papers of the activities emanating from the Research Commission. It is hoped that the recommendation herein before made will be approved and that these valuable data will be appended. As noted, the activities at the Bureau of Standards were only inaugurated April 1, 1928, and, since then, more than 600 pages of reports and papers relating to this cooperative program have been published.

This St. Paul paper was published in the July 1935 issue of THE JOURNAL, pages 1172-1185. The specific recommendation mentioned in the quoted paragraph will be found on page 1180, under the heading "Many Contributors" and, for convenience, it is herein incorporated.

Since the commission began functioning in 1913, a great number of research workers have been engaged in various problems and have made many valuable contributions, most of which have been published in THE JOURNAL or other dental or scientific publications. In the allocation of these grants, it was definitely agreed that due credit was to be given to the Research Commission, in all papers and reports, and that THE JOURNAL had first claim on publication. The executive board was given authority to approve of publication elsewhere, provided THE JOURNAL could not publish such papers and reports without too much delay. Unfortunately, there has never been a complete list of these research data compiled as a separate publication, but it seems that this would be quite beneficial to future investigators. Therefore, it is recommended that the Library Bureau be requested to assemble these data, and, if possible, append hereto as a supplement, or give definite reference as to its publication. About three years ago, I discussed this question, through correspondence, with the Librarian, to whom all this information is accessible. I recently submitted another in-

Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-Seventh Annual Session of the American Dental Association, New Orleans, La., November 5, 1935.

*On authorization of the Research Commission, the writer was requested to incorporate the subsequent activities of the Commission to June 30, 1938, in order to publish a more complete history in THE JOURNAL.

*Revised and supplemented, including all activities and reports to October 20, 1938.

quiry and herein incorporate the following paragraph from Mrs. Hunt's reply:

"In 1931 consideration was given to making such a list, but on studying the subject it was found to be a most difficult list to compile as neither the Index to Dental Periodical Literature nor the indices of the individual dental journals indicated whether or not the paper was done as a result of a Grant from the Research Commission of the American Dental Association."

This recommendation was approved by the Research Commission, but the list was not prepared and appended; therefore, the officers of this Section requested me to compile and present these data. In undertaking this assignment, I fully recognized the difficulties mentioned by Mrs. Hunt, and in view of this complicated situation, I sought the aid of the present and former advisers, who represented the Research Commission in the various cooperative programs wherein grants from the commission were made to assist in the various researches, and, as a general rule, they promptly complied with my request. Quite naturally, I was very desirous of giving full credit to every contributor, and felt confident that these advisers and their associates were equally anxious to make this a dependable record. Furthermore, I considered that this procedure would supply the most reliable information on the one hand and, at the same time, save considerable time in reviewing so much literature; also, this plan would tend to relieve me of some criticism from such contributors as might not be included.

EARLY HANDICAPS

In the early years of this important activity, the Research Commission was confronted with a considerable handicap in not being able to publish all the reports and papers in THE JOURNAL. This was due to the fact that limited space did not permit of publishing all these and the other preferential material submitted to THE JOURNAL. Therefore, the compiling of a dependable list of contributors, since the first Research Committee was appointed in 1908, is a difficult and complicated task, and this is especially true since the creation of the Scientific Foundation and Research Commission at the time that reorganization of the National Dental Association went into effect, at the Kansas City meeting in 1913. Thus, in view of the elapsed time, it should be generally recognized that it will be quite impossible to assemble this list without making some errors. Furthermore, I am quite certain that some papers will be listed for which there was no financial assistance provided; but the research spirit developed as a result of the commission's activities was directly responsible for continued investigations in correlated problems, and, for that reason, there may be a justification for including some borderline cases.

COMMENDATION OF ORIGINAL RESEARCH WORKERS

The initiative and enthusiasm of the original workers in dental research is to be highly commended and special mention should be made of Henry C. Ferris, Weston A. Price, Thomas B. Hartzell, Percy R. Howe and Russell W. Bunting. In fact, this list could be extended to include many others.

As an evidence of the stimulating influence of the activities of the Research Commission, I incorporate herein a report submitted by Edward H. Hatton, through Arthur D. Black, the adviser at Northwestern University Dental School, as follows:

SUMMARY OF ACTIVITIES SUPPORTED BY GRANTS FROM THE RESEARCH COMMISSION OF THE AMERICAN DENTAL ASSOCIATION 1920-1931

Department of Pathology and Bacteriology, Northwestern University Dental School

1. A grant initiated the work on pulpless teeth, studied from two points of view; namely (a) the nature and character of the

histologic changes following pulp canal treatment, and (b) bacteriologic studies of pulpless teeth. The first problem was in a large measure transferred to Dr. Skillen's department after the pioneer work had been done.

Under the first head (a), not less than seven different articles were published from this laboratory, exclusive of those originating from Dr. Skillen's department. These have been quoted from, abstracted or reprinted in almost every reputable dental journal in the world. (Dr. Bebb once brought me a Spanish journal printed in South America with the comment, "Here is a very fine article; although I do not read this language, I can recognize the quality of the article by the character of the illustrations." I could hardly believe my eyes, for he was showing me some of my own pictures. There was no mistaking them, and was I mad! Anger was replaced by a more agreeable state of mind when closer examination disclosed that the whole article was an excellent translation of my original article with all due credit to both the author and translator.)

Under the second division (b), quite as much work was done, although fewer articles were published, not more than three. As this work was less spectacular and merely confirmed the opinions based on clinical experience and x-ray examination as to the freedom of the majority of adequately treated x-ray negative pulpless teeth from infection, it has received less attention than the work mentioned above.

2. Grants were used to study the subject of focal infection. Partly as the result of this work and partly owing to the relationship of the investigations on pulpless teeth to focal infection, a large number of articles have been published, certainly more than ten. The papers in this group have received generous consideration as judged by the frequency with which they have been referred to, quoted from and abstracted.

3. One grant was made and applied to the study of saliva. Only one report was published in connection with this research. On the other hand, this preliminary study laid a foundation for the fine work now being done in this field by other departments in this school.

Personally, I cannot complete this report without stating my own deep and lasting feeling of gratitude and appreciation for both the financial and the moral support of the Research Commission at a time when both were needed.

Submitted by

EDWARD H. HATTON.

William G. Skillen submitted a separate report, from which I incorporate his closing paragraph:

> Some of these studies are still being carried on in various directions, their motivation having been stimulated during this period.

In addition to the foregoing statements, there is additional evidence that the influence of the Research Commission on the dental profession and the dental colleges has been a potent factor in furthering research. This is also true of the manufacture of dental materials following the inauguration of the cooperative program at the National Bureau of Standards.

I also wish to acknowledge the cooperation of the United States Public Health Service in initiating a study on mottled enamel when the Research Commission did not have sufficient funds to undertake new problems. I am also hopeful that this important Federal Department will soon inaugurate an adequate research program in dental caries, with funds allocated from the $2,000,000 provided in the Social Security Act for the investigation of diseases and problems of sanitation. The need for this was strongly emphasized in the October 20, 1935 issue of the *Columbus (Ohio) Dispatch*, wherein it was stated that 606 of 685 applicants for enlistment in the U. S. Navy, since January 7, 1935, were rejected for physical reasons, 241 being attributed to dental defects. This fact, together with the oft-repeated statistics of rejection of draftees during the World War, for the same reason, should initiate a concerted and constructive program of dental health education in all health, educational and welfare activities.

COMPILING LIST OF CONTRIBUTORS

In view of the fact that this compila-

tion will be dissociated from my published article of last year, I shall include the reports and papers specifically mentioned therein, in order that this may be as nearly complete as is possible, and incorporated in one publication, so that it will be more readily available for reference purposes. The reports and papers incorporated in my St. Paul paper, and hereinafter repeated, relate principally to the early organizational work.

In attempting to avoid any criticism in the order of listing of these contributors, it has been thought advisable to insert them alphabetically, except where a number are working on one cooperative project, such as the various university groups and the National Bureau of Standards. Therefore, this procedure will be adhered to as far as is practical, as follows:

CONTRIBUTIONS OF HENRY C. FERRIS

Reports as chairman of Committee on Scientific Research. N.D.A. Trans., 1908, p. 116; 1910, pp. 65-69; 1911, pp. 78-95; 1912, pp. 96-100; 1913, pp. 53-62.

Pathological and Physiological Variations in the Composition of Human Saliva. J.A.D.A., 1923, p. 19.

Further Studies of Physiological and Pathological Variations in the Composition of Human Saliva. (This was not published because of its length and the limited JOURNAL space.)

CONTRIBUTIONS OF WESTON A. PRICE AND ASSOCIATES

PRICE, WESTON A.: The Behavior of Gold in Fusing and Casting. N.D.A. Trans., 1910, pp. 101-134.

Report of Committee to Inaugurate a Research Program. N.D.A. Trans., 1913, pp. 6-10.

Report of Progress. N.D.A. Bull., November 1913, pp. 15-18.

National Dental Association Scientific Fund. *D. Items Int.*, 1913, pp. 298-300, 630-632.

Report of Executive Board, Research Commission. N.D.A. Bull., June 1914, pp. 30-33.

(and F. A. FAHRENWALD): Metallurgical, Physical, and Electro-Chemical Researches. N.D.A. Bull., October 1914, pp. 71-109.

(and F. A. FAHRENWALD): Special Research in Physics. N.D.A. Bull., October 1914, pp. 110-121.

Reports of Researches in Progress Under the Auspices and Support of the Scientific Foundation and Research Commission. N.D.A. Bull., October 1914, pp. 122-123.

(and F. A. FAHRENWALD): Some Practical Uses in Dental Practice for Tungsten and Molybdenum. N.D.A. Bull., 1915, pp. 39-45.

Research Fund Report. Progress Securing Funds for Conducting Dental Researches. N.D.A. Bull., May 1915, pp. 166-168.

Report of Scientific Foundation and Research Commission. N.D.A. Trans., 1915, p. 396.

Prevention of Systemic Diseases Arising from Mouth Infections and the Purpose and Plan of the Research Institute of the National Dental Association. *Cleveland M. J.*, October 1915, p. 667.

Progress of the Research Commission of the National Dental Association. (Report of Metallurgical Researches.) *D. Digest*, 1916, pp. 55-56.

Address at opening of the Research Institute of the National Dental Association. J.N.D.A., 1916, pp. 158-160.

Report of the Acting Managing Director of the Research Institute to the National Dental Association. J.N.D.A., 1917, pp. 97-108.

Annual Report to the House of Delegates of the National Dental Association from the President of the Research Institute and the Chairman of the Research Commission. N.D.A. Trans., 1918, pp. 100-111.

Annual Report of the President of the Research Institute of the National Dental Association and the Chairman of the Research Commission. N.D.A. Trans., 1919, pp. 44-51.

Report of Research Institute and Research Commission. N.D.A. Trans., 1917, pp. 34-43.

(and SAMUEL E. POND): Electrolytic Medication (Physiological and Dental Aspects). J.N.D.A., 1918, p. 601.

Report of Laboratory Investigations on the Physical Properties of Root Filling Material and the Efficiency of Root Fillings for Blocking Infection from Sterile Tooth Structure. J.N.D.A., 1918, pp. 1260-1280.

Report of the Research Commission to the Members of the House of Delegates of the American Dental Association. A.D.A. Trans., 1922, pp. 63-66.

BARBER, LAFAYETTE L.: President's Address (Reference to Research Commission). J.N.D.A., 1917, p. 1282.

BROWN, HOMER C.: Greetings from the President (Reference to Scientific Foundation and Research Commission). N.D.A. Bull., November 1913, p. 5.

President's Address. (Reference to Scientific

Foundation Research Commission.) N.D.A. Bull., October 1914, pp. 8-9.

Secretary's Report, Research Commission. A.D.A. Trans., 1928, pp. 113-125.

Secretary's Report, Research Commission. A.D.A. Trans., 1929, pp. 93-112.

Secretary's Report, Research Commission. A.D.A. Trans., 1930, pp. 172-187.

Secretary's Report, Research Commission. A.D.A. Trans., 1931, pp. 200-214.

Secretary's Report, Research Commission. A.D.A. Trans., 1932, pp. 318-328.

Legislative and Research Activities of the American Dental Association Together with a Résumé of Some Essential Factors Closely Related to Our Professional Advancement. J.A.D.A., 1930, pp. 51-69.

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(To be continued in April issue)

BUREAU OF PUBLIC RELATIONS

CLINICAL AND CHEMICAL SURVEY OF FLUORIDES IN THE PROPOSED SOURCE OF WATER SUPPLY FOR THE CITY OF NARKA, KAN.

By LEON R. KRAMER,* D.D.S., Topeka, Kan.

THE town of Narka, Kan., is situated just a few miles south of the Nebraska line in Republic County. Owing to its distance from a river or stream that would be a dependable source of water supply, the city must depend on deep wells to meet its needs. As shallow wells were disappointing because of their inadequacy, two deep wells were drilled, and it was only after the second well was drilled to the depth of 262 feet that a sufficient amount of water was found.

Samples of water from both wells were sent to the division of sanitation of the Kansas State Board of Health. The findings of the analysis were: bicarbonates, 362 parts per million; chlorides, 206; iron, 0.16; fluorides, well No. 1, 1.2; well No. 2, 1.3. Since the fluoride content was above the generally acceptable allowable amount of 1 part per million, the division of sanitation asked the cooperation of the division of dental hygiene in setting the minimum or threshold value of a water that can be safely used.

The director of the division of dental hygiene immediately interviewed E. F. Keene, the mayor of Narka, who is also a dentist and has practiced in the region since 1911. He is the only dentist in the north half of the county. He stated that in all his years of practice he had not seen in his territory a case of mottled enamel, which is caused by an excess of fluoride in drinking water. He also said that fully 50 per cent of the people used water from deep wells. Since the fluorine content was 0.3 part per million higher than the allowable amount, the problem seemed sufficiently interesting to make a survey of deep wells surrounding the city wells Nos. 1 and 2, and to examine the teeth of children and adults who had been reared where deep well water was the sole source of water supply.

DENTAL EXAMINATION OF SCHOOL CHILDREN

Approximately 100 children, aged 8 to 17, were examined, of which 50 per cent used water from shallow wells and the other half used water from deep wells. W. E. Nippert, principal of the high school, and Mary Anthony, principal of the grade school, cooperated. In the presence of Mr. Nippert, Miss Anthony and Dr. Keene, the director of the division of dental hygiene made a complete dental examination of the entire group. Not a single case of mottled enamel was found.

*Director, Division of Dental Hygiene, Kansas State Board of Health.

DENTAL EXAMINATION OF ADULTS

Dr. Keene then asked several adults to come to his office to have their teeth examined. These persons were born and had spent most or all of their lives on farms supplied by deep water, of which it was the intention to obtain samples. Each of the four adults had excellent teeth and there was no trace of mottled enamel.

COLLECTION OF WATER SAMPLES

Samples of well water used by the persons examined were then collected and each sample was labeled. The number, the name, the depth of well and history of the person using the water was written on each label. The examinations were made and the samples of water collected December 21 and 22, 1938. The water samples were delivered to the division of sanitation, December 23, 1938.

The report of the analyses of the water samples was mailed from the division of sanitation to the division of dental hygiene December 29, 1938. The report is given in the accompanying table.

The report of the division of dental hygiene to the division of sanitation was as follows: "In face of the evidence of the above findings, we do not believe that the fluorine content of 1.3 parts per million (well No. 2, city of Narka) is sufficient to present a hazard to public health in the form of fluoride poisoning."

DEDUCTIONS

Since hundreds of towns in arid regions must depend on deep wells for an ample supply of water, it is a matter of great concern, as to not only the availability of water, but also the cost of procuring a sufficient quantity of water, to set the allowable amount of the fluorine content as high as possible.

The amount of bicarbonates or chlorides may have some bearing on the toxicity of fluorine-bearing water. The water from the Narka city wells is high in both bicarbonates and chlorides.

The findings reveal that with a fluorine content up to 3 parts per million in deep well water in and around Narka, Kan., there was no clinical evidence of mottled enamel. Since the cost in time and money in making a clinical and chemical survey to determine the toxicity of fluorine-bearing water in a locality is negligible, a survey of this type seems to offer a logical and practical way to determine the factor of tolerance in any given area.

WATER ANALYSES

Source	Fluoride Parts per Million
Sample 1	
½ mile north of Narka, E. E. Holly farm, depth 240 ft.	
Kenneth Holechek who lived on farm until he was 20 years of age has no mottled enamel.	3.0
Sample 2	
1 mile south of Narka, Lee Feil farm, depth 280 ft.	
Two children, now past 20 years of age, have no mottled enamel.	0.8
Sample 3	
1 mile north, ½ mile east, Harrold Holly farm, depth 242 ft.	
Man aged 32 who has lived on farm entire life has no mottled enamel.	2.1
Sample 4	
1½ miles north, 1 mile east, Charles Tuma farm, depth 212 ft.	
4 children of school age, born and reared on farm, have no mottled enamel.	1.8
Previously reported (11-30-38)	
No. 1, city well	1.2
No. 2, city well	1.3

THE ORAL HYGIENE PROGRAM OF THE NEW YORK STATE DEPARTMENT OF HEALTH

By DAVID B. AST,* D.D.S.

THE Oral Hygiene program as planned and presented through the Division of Maternity, Infancy and Child Hygiene of the State Department of Health is rapidly taking shape and should be in full swing in several sections of the state by the time that this is published.

With the cooperation of the State Dental Society's Advisory Committee consisting of: Dr. Harvey J. Burkhart, Dr. E. R. Rhinehart and Dr. James T. Ivory, and other interested members, we have been able to formulate a plan which will be used as the basis for an extensive campaign in preventive dentistry. The proper starting point for such a plan must of necessity be where we can build a firm foundation, and then our job is to keep that foundation from crumbling. Therefore, we plan to work with the prenatal patients and children of preschool age. Through a campaign of education in oral prophylaxis, diet and nutrition, and stressing the importance of early correction of dental defects, plus the cooperation of the members of the dental profession in caring for incipient caries, with special emphasis on the preservation of the first permanent molars, we will be taking a long step in the right direction.

At the same time that the prenatal and preschool age consultations are carried on in the health department clinics, our dental hygienist will be present to carry on a campaign of education, and will give a thorough prophylaxis to each patient. Through the use of charts, models, literature and by word of mouth she will get her message over to the parent of the child. She will instruct the patient in the proper use of the toothbrush and will try to instill in the young patient a desire to cooperate in maintaining oral hygiene. She will also fill in on our examination chart the history indicated and will mark those teeth in which dental defects are evident.

Through committees of the local dental societies, components of the district societies, we will obtain a list of the local dentists who are willing to cooperate with us in this program in taking care of the necessary corrective treatments. It is preferable to have the corrective treatments done in the private practitioner's office rather than to set up dental clinics all over the state. The fee for the dentist for his services in his office, using his own equipment and supplies, will be $12.50 for a three-hour session, which time must be set aside exclusively for these treatments. If he is to work in a health clinic, his fee will be $10.00 for a three-hour session. Only minimal corrective procedures are to be followed such as: amalgam fillings, synthetic porcelain fillings, cements, only in cases where exfoliation due to root absorption is imminent, extraction of badly decayed teeth and remaining roots, prophylactic odontotomy performed in six year molars. No root therapy is to be undertaken in deciduous teeth. The use of silver nitrate reduced with eugenol or other reducing agent in pits and fissures is advised.

*Assistant Director for Oral Hygiene.

These services are to be rendered to welfare patients and those borderline cases which are found to be unable to pay for their dental needs. All other patients will be directed to their family dentists and through the public health nurse will be followed up to see that they take care of the necessary corrections.

Provision is made in the Public Health Law for financing of public health programs through State Aid to Counties. Usually this amounts to Boards of Supervisors appropriating certain sums for this work, which funds are then matched by the State Health Department. In the case of a dental program, the State Health Department may be able to initiate a program on a demonstration basis without the use of local funds for the first year. The second year the county is expected to appropriate two-thirds of the cost of the plan and through State Aid to County Funds will be reimbursed to the extent of fifty per cent of its appropriation. The final third of the cost of the plan will be paid through federal funds. Ultimately it is expected that the plan will be carried by the county appropriation and State Aid to County Funds on a fifty-fifty basis.

I am not so optimistic as to feel that with even an unusually successful program we can do away with all dental caries, but I do know that we can prevent gross, rampant caries with the resultant loss of teeth, and the shifting of remaining teeth, leaving the patient a dental cripple.

Since preventive dentistry is the most pressing problem facing the dental profession today, dentists everywhere should shoulder their responsibilities by doing their utmost to spread the gospel of good dental health. Talk health dentistry to your patients and make children's dentistry an integral part of your practice.—*Bull. D. Soc. New York, January 1939.*

AMERICAN DENTAL ASSOCIATION EXHIBIT, GOLDEN GATE EXPOSITION, SAN FRANCISCO, CALIF.

AMERICAN dentistry tells its story of dental health at San Francisco's Golden Gate International Exposition with what many observers believe is the most ambitious as well as one of the most practical scientific exhibits ever developed.

All the elements of masterful educational showmanship have been utilized to inform the exposition visitor of the progress which dentistry has made from the days of the early practitioner to modern times, with emphasis on the value of dental health to personal appearance, economy and general well-being.

It has cost approximately $20,000 to tell the story, but the American Dental Association is convinced that every visitor to the exposition's Hall of Science will study the exhibit with rapt interest and come away with definite ideas of the important rôle dentistry plays in the modern scheme of living.

The exhibit is 52 feet long and 25 feet deep, covering 1,300 square feet. It is modernistic in design and beautifully colored in pastel shades, harmoniously

blending from the rich ultramarine flooring to the brilliant lemon lintel. The design, color scheme, lighting and electrically motivated effects are bound to attract the Hall of Science visitor, and the exhibit offers enough entertaining and educational action to hold the visitor's attention from the first to the last chapter of American dentistry's story.

The exhibit was constructed under the direction of the American Dental Association, by the Firks Studios, in Chicago. The same firm made the American Medical Association's exhibit for the Golden Gate Exposition. Two freight cars, one 50 feet long and another 36 feet long, carried the two exhibits to California, where they were placed side by side in the Hall of Science on Treasure Island.

Entering the exhibit at the left, the visitor sees pictured the face of a beautiful girl, whose beauty changes before the eyes of the observer as her teeth change. An ingenious drumlike device inside the model head allows it to smile in turn with perfect teeth, crooked teeth, decayed teeth, an open bite, slovenly teeth and teeth missing.

Between each two changes, the head disappears and the visitor finds herself looking into a "magic" mirror, a psychologic touch which invariably makes the visitor look at her own teeth while waiting for the next smile from the model head.

The display points out that "Loveliness Depends on Health and Good Looks," adding that "Every Woman Knows That Beautiful Teeth Are a Personal Asset."

The second display recounts the history of dentistry in eighteen effectively colored and illuminated translight pictures. It presents a pictorial history of dentistry dating back to the extraction of teeth of 2,600 years ago as described by ancient Assyrian cuneiform tablets; takes the visitor through the "glowing iron" gum treatments of the thirteenth century; portrays the barber-dentist of the 1500's and progresses up through the centuries to the modern dental office, with other dental milestones well noted in each picture.

"Victims of Civilization," the subject of Display No. 3, portrays in hand colored translights the effect of the white man's diet on the teeth of primitive Aborigines of Australia and the primitive races of Africa, New Zealand, South America, North America and the Arctic regions. The material is based on studies of Weston A. Price, of Cleveland, Ohio.

The fourth exhibit acquaints the visitor with the intricacies of manufacturing porcelain teeth, while the fifth display recounts the history and the progress of denture making. The earliest type of denture shown dates back to 1780—a handcarved ivory partial denture. This exhibit is lent by the Northwestern University School of Dentistry.

Traveling through the exhibit, the visitor's attention is attracted by an educational exhibit anent "Orthodontia," lent by the University of California. "Before" and "after" face masks show crooked teeth and misshapen jaws and demonstrate how the skill of the modern dentist can correct them. (Display No. 6.)

Display No. 7 drives home the ravages of decay. A 3-foot transparent tooth is electrically motivated to show how decay attacks the enamel and the softer dentin beneath and how it eventually attacks and kills the pulp, causing an abscess to form at the root end. It also shows how infection can be carried by the blood stream from the abscess to other organs of the body.

The center exhibit, Display No. 8, shows alternately, by means of complicated and intricate lighting, a dental office of 1889 and a dental office of today. This exhibit, perhaps more than any other, impresses upon the visitor the progress made by dentistry in the last fifty years. Display No. 9 shows how the presence of tartar on teeth can result

AMERICAN DENTAL ASSOCIATION EXHIBIT, GOLDEN GATE EXPOSITION, SAN FRANCISCO, CALIF.

Dentistry's story will be dramatically presented to the Golden Gate Exposition visitors from February 18 to December 1, 1939. Located in the Hall of Science, this beautiful 1300 square foot exhibit has been made possible by the cooperation of the American Dental Association, the California State and the Southern California dental societies, the San Francisco and the Alameda County dental societies and the dental manufacturers and dealers.

in pyorrhea and emphasizes the importance of having the teeth scaled and polished by the dentist regularly. Here, also, the visitor learns how poisons from oral disease can undermine other parts of the body.

The College of Physicians and Surgeons of San Francisco, School of Dentistry, has lent exhibit No. 10, which shows what modern dentistry can do in mouth reconstruction, contrasting near-perfect modern results with those of the crude efforts as shown in a pictorial history of dental reconstruction.

Displays No. 11 and No. 12 show the important rôle that x-rays play in dental health, stressing the necessity of having an oral x-ray examination at least every two years. Films are shown of impacted and supernumerary teeth, pyorrhea pockets, gum recession, bone resorption, jaw fractures and other hidden conditions. This exhibit is lent also by the College of Physicians and Surgeons of San Franciso, School of Dentistry.

The keynote of modern dental care is sounded in Display No. 13, which deals with preventive dentistry. Preventive care is demonstrated by means of beautifully colored translights through the prenatal period to adulthood, stressing the importance of diet, cleanliness and frequent dental attention.

A man's head, similar to the woman's head in Display No. 1, attracts the visitor at stop No. 14. Here, by the same drum-like arrangement which alternately shows good and various types of bad teeth, the visitor sees himself in the transparent mirror as the types of teeth change. The visitor is reminded, meanwhile, that "Efficiency Depends on Health and Intelligence" and that "Every Man Knows That Healthy Teeth Are a Business Asset."

Display No. 14 completes the educational messages of the exhibit's murals, but four additional exhibits, among the best from the standpoint of entertaining and educational action, are housed in floor cases in front of the exhibit proper.

The first of the floor cases, Display No. 15, shows the phenomena of tooth eruption in model heads from the ages of 8 to 10 months until the child is about 11 or 12 years old. More mechanical ingenuity allows for the eruption of the teeth through the gums. The content of Display No. 15 was furnished by R. F. Goering, of Duluth, Minn., and R. H. Johnson, of Chicago. No. 16 is an exhibit of tooth carvings and models, portraying the long and exact period of training that a dental student must go through before he is permitted to practice. This exhibit is presented through the courtesy of the College of Dentistry, University of Southern California.

The School of Dentistry, North Pacific College of Oregon, is the donor of Display No. 17, a complete study of dentures, both full and partial, the display being devoted to prosthodontics. Finally, but by no means the least important of the displays, is a series of facial masks, with and without dentures, lent by C. G. Grover and Miss R. Kallminzer, of Denver, Colo. These lifelike models show how the facial contour can change with loss of teeth and how it can be restored to normal by the dentist.

In a prominent place in the exhibit, the American Dental Association has placed a question box, in which visitors can place inquiries, which will be answered by the committee in charge.

Thus, the American Dental Association, with the hearty cooperation of the California State and the Southern California dental societies, the San Francisco and the Alameda County dental societies and the dental manufacturers and dealers, will tell the story of dental health to

the millions who visit the 1939 Golden Gate International Exposition at San Francisco. This unique and artistic exhibit of dentistry is another step in educating the American people regarding the rôle which the dentist plays in the promotion of personal, public and economic health.

THIRD PRIZE WINNERS, NATIONAL POSTER CONTEST

In the January and February 1939 issues of The Journal, illustrations were shown of the posters that won first and second prizes in the 1938 National Dental Health Poster Contest, together with photographs of the children who made them.

Annie Sampson, La Conner, Wash., third prize winner for rural schools.

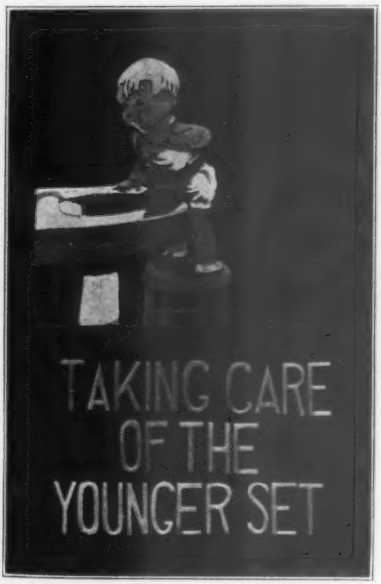
Herewith are shown illustrations of the five posters that won third place and their designers.

Third place honors were won by Annie Sampson, La Conner, Wash., rural schools; Raymond Becker, Jr., Uniontown, Pa., elementary division; Helen Kalil, Fall River, Mass., junior high division; Frank Katus, Peoria, Ill., senior high division, and Jack McNiff, St. Louis, Mo., vocational division.

Third prize winning poster for rural schools; by Annie Sampson, La Conner, Wash.

Raymond Becker, Jr., Uniontown, Pa., third prize winner for elementary schools.

Third prize winning poster for elementary schools; by Raymond Becker, Jr., Uniontown, Pa.



Third prize winning poster for junior high schools; by Helen Kalil, Fall River, Mass.

Helen Kalil, Fall River, Mass., third prize winner for junior high schools.

Third prize winning poster for senior high schools; by Frank Katus, Peoria, Ill.

Frank Katus, Peoria, Ill., third prize winner for senior high schools.

Jack McNiff, St. Louis, Mo., third prize winner for vocational schools.

Third prize winning poster for vocational schools; by Jack McNiff, St. Louis, Mo.

DENTAL ECONOMICS

THE UTILIZATION OF COMMUNITY RESOURCES IN THE HEALTH PROGRAM

By Emory W. Morris, D.D.S., Battle Creek, Mich.

FOR the past five years, the W. K. Kellogg Foundation has been cooperating with the people in seven counties in southwestern Michigan in an effort to determine to what extent local resources can be utilized to provide more adequate health service for children. Too often, when an outside agency endeavors to help a community with some of its health problems, it assumes the entire responsibility for the planning and administration of the projected program, without recognizing that every community has resources, both human and physical, that, if properly coordinated and directed, can provide adequate health service for the majority of its population. Past experience has shown all of us that the provision of service is primarily a financial, personnel and educational problem. Generally speaking, if financial assistance is sufficient, personnel can be secured and a better health service be provided, but, in too many instances, programs that have assumed the entire personnel responsibility have collapsed when financial aid was withdrawn, and the local people have not been educated to assume their rightful responsibility.

The W. K. Kellogg Foundation has assumed the attitude in this project that this is a program of the people in the area, the children are their children, the responsibilities their responsibilities, and the project will be just as successful as the people make it. The communities are not being told that they should have such and such health and educational machinery; nor is the program being planned with the idea of promoting particular systems to meet evident needs, but rather to bring to the various groups concerned, through their own leadership, the best of thought in the various professional fields and to let the people directly concerned work out their own solutions.

The majority of communities have in sufficient number dentists, physicians, teachers, nurses, lay leaders and other interested groups who, if properly guided and directed and given the opportunity to work with some of their own problems, can in many cases work out their own solutions. No one group is sufficient in itself, but is dependent on the interest and cooperation of all others. A dental program for an area cannot be developed as a thing apart from all other programs affecting the health of the community. In the past, we have overemphasized the importance of dentistry in its relation to all the other programs designed to promote health. If we are sincere in our belief that the whole child should be considered, let us develop the dental program so that it can be integrated in the

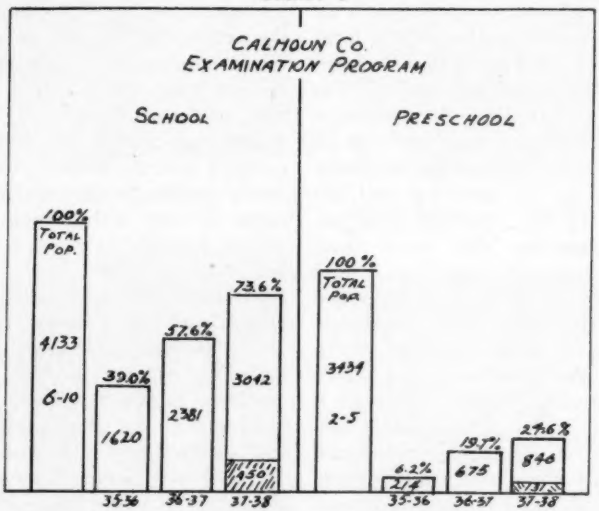
From the Kellogg Foundation.

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighteenth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

general health program, in its proper place and where the greatest good can be accomplished for the greatest number, rather than developing self-sufficient machinery for dentistry with total disregard for the machinery being developed for the same child in other phases of health. The majority of dental health programs impose on the school child special health classes at designated times, require special consideration and time to examine school children and conduct toothbrush drills and contests—literally turn the school programs topsy-turvy trying to create the proper attitude toward dentistry and provide the child with sufficient knowledge regarding dental health to assure him that he will not go through life a dental cripple.

Health instruction so conducted is the most ineffective teaching which is done in any part of the school curriculum today. In spite of the time and attention which are being given to health work, it is generally recognized that the results of such teaching are not very great. Habits and attitudes regarding health practices are influenced but slightly by such health teaching procedures. This state of affairs is probably due to the fact that teachers have not learned how to teach health so well as they have learned to teach the tool subjects. A second possible explanation for the ineffectiveness of health instruction lies in the fact that the majority of health habits are practiced at home. We preach about them in school, but the child does not have any opportunity to practice them in school. The majority of teacher schedules are so overloaded that they violate the best principles of mental hygiene and integrated learning. Today, we are thinking in terms of maternal health, infant health, preschool health and school health, all based on the child development theory which stresses children's experiences. Dentistry has its important part to play in each of these fields, but let's so develop our program that we can do our part of the job in the most effective way, properly integrating it with all other programs designed to promote normal growth and development; then dental needs will become associated in the minds of the public as something that is closely related to

CHART 1

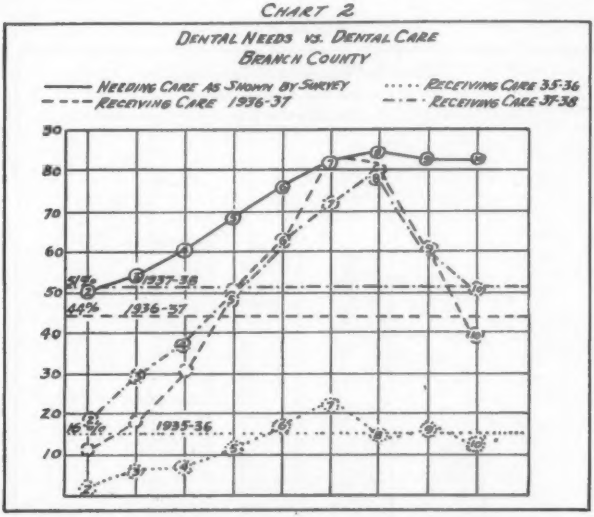


the child's needs, and not a separate entity.

There are one hundred dentists practicing in these seven Michigan counties, no different five years ago from any other one hundred dentists who might be selected from any part of the country—some exceptional men, some average and others with little interest in dentistry or any of its problems, each conducting his own individual practice and wondering what the fellow across the street or in the neighboring community was doing and thinking, but not sufficiently concerned to find out. Less than 25 per cent were members of organized dentistry, and these had never gathered as a county group to consider their place and responsibility to their community and society at large.

The first step in the development of this program was the organization of county dental societies—small groups, with common problems and a desire to be of assistance where possible, provided guidance would be given and a program be developed which it was within the limits of their ability to carry out. This proved to be a major consideration as the program progressed. The health department, which is the administrative unit in this program, informed members of the dental group that it was desirous of seeing how far they could go in providing adequate dental service for the children in their communities; that any program developed would be their program and routine as far as the practice of dentistry was concerned, and that the health department desired to utilize only available facilities, resources and personnel and go as fast or as far as the dental society deemed advisable.

CHART 2

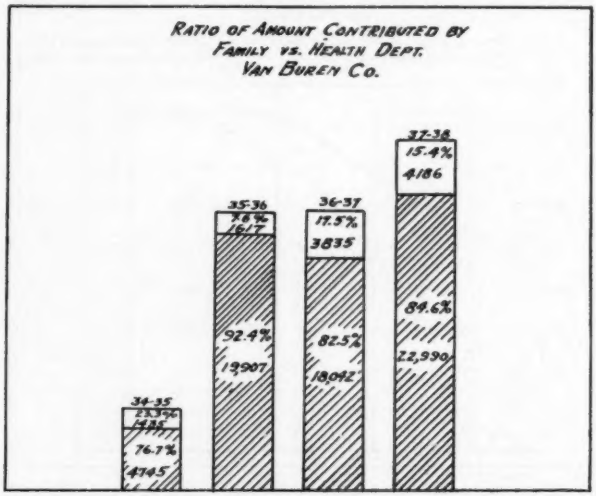


The dental society and the health department felt that in the problem of providing adequate dental service there were three factors: 1. A demand for dental service must be created. 2. The demand, once created, must be supplied. 3. Sufficient money must be available to provide service for the groups involved. The county health department stated that it would assist them with the first factor; that is, the education, and also provide the wherewithal for the third factor, if the dentists would take care of

the second factor, that of providing the service when the demand for children's dental care was created. It was pointed out to the dental group that 80 per cent of the population were without dental care and that this 80 per cent were not receiving it because of (1) lack of education as to the value of dental service and (2) economic conditions. It was also mentioned that no program had been developed to determine what percentage of the population would secure service if educated and what percentage would always need financial assistance if they were to have adequate dental service. It was also pointed out that an effort must be made to provide a type of service that a majority of the population could afford. It is evident that curative dentistry as practiced today does not answer the problem. The answer may lie in practicing preventive dentistry, which should start at an early enough age that we will never have a curative problem that involves expensive operative procedures. We cannot today, with known measures, prevent decay of the teeth, but we can prevent loss of teeth and the accompanying complexities provided continuous care can be started at an early age and carried out for the lifetime of the individual. And herein may lie the solution of the economic problem for a large percentage of the population. A great many more people can afford the small cost of periodic treatment than can afford large bills for curative care at infrequent intervals. All this serves as the basic philosophy for the development of the dental program.

Assurance was given the dental group that a program equally comprehensive to promote the health of children was going to be planned with all other groups in the community; that is, physicians, school superintendents, teachers, school janitors, ministers, county supervisors, editors, county and township committee people, lay leaders, veterinarians, adult groups and any others who have a part to play in community health. It is essential that all these groups, as well as the dentist, have adequate information and an understanding of the entire health problem; for the child's attitude toward going to the dentist is not dependent only

CHART 3



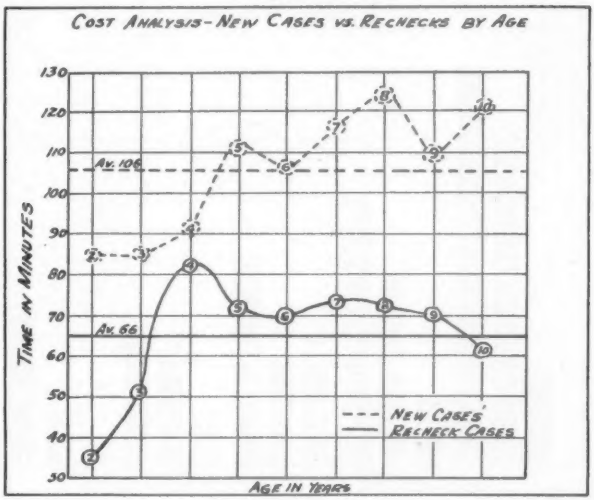
on what the dentist says or thinks, but rather on the total of all the forces with which the child comes in contact.

The dental group, although somewhat dubious as to where it might lead, adopted this general philosophy, but with the belief that a constructive effort should be made to answer some of these problems. The first program agreed on was an examination of school children, not with the idea of determining the number of defects by grade, age or tooth, but solely for its educational value to the child, the parent, the teacher and the dentist. The examination was to be given by the family dentist in his own office because it was thought that this would give greater educational value to the examination, even though only 50 per cent of the children were examined in the dentist's office as against 100 per cent if examinations were made in the school.

It is routine, as far as the practice of dentistry is concerned, first to select a dentist and then to make an appointment for examination and correction of defects. The dentists believed that this experience should be provided the child in the dental office rather than to lead him to feel that the school would provide for his care and assume responsibility for his health. Every child should eventually develop a plan with his own dentist for the care of his dental health, but until such time as he is capable of planning for himself, others in the home, school and community must plan cooperatively with and for him. The dental office was chosen in preference to the school because the dentist is able to do much more effective educational work in his own office, where he is working with each child as an individual problem and in the absence of all the distractions usually accompanying the school examination. In this rôle, the dentist must become the instructor, and rightfully so, for he is the logical person in the community to give advice on dental health problems.

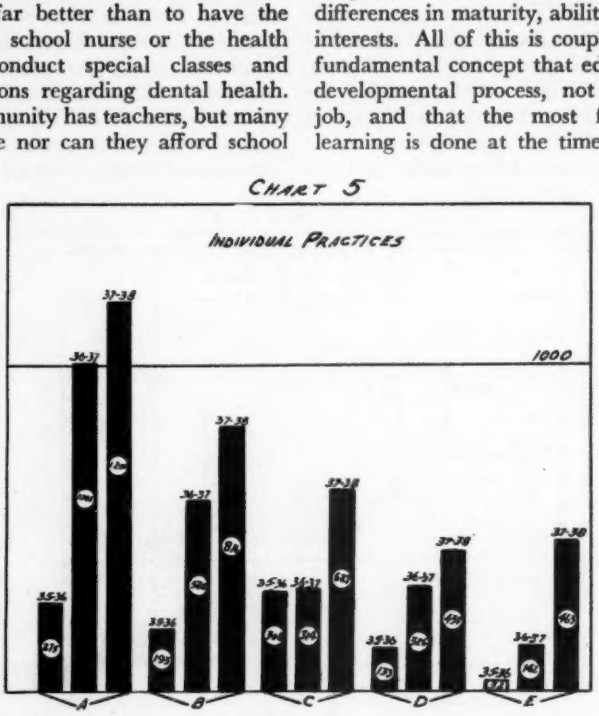
It was at this juncture that some of the other machinery in the community was brought into the program. The dental group was desirous that the child have a knowledge of certain facts concerning dental health before going to the dental

CHART 4



office, and the logical person to assist in this program was the teacher. To have the teacher provide the child with sufficient facts regarding dentistry and then suggest that the child make an appointment with his family dentist for additional information and examination would be far better than to have the dentist, the school nurse or the health educator conduct special classes and demonstrations regarding dental health. Every community has teachers, but many do not have nor can they afford school nurses, health specialists and others especially trained to do this type of work.

CHART 5



If the teachers were to handle this particular part of the program, in relation not only to dental health, but also to all the other programs, they must be given a different point of view through additional training. The effectiveness of the teacher's work in the health field is dependent on her understanding of the whole child, for the whole child comes to school. The teacher's program for the child depends on the background of the child, the condition of health and emotional balance in which the child is found on any one day, the social adjustment of the child in the class group, the maturation of the various elements of the total child as it relates to the child's receptiveness to new ideas and the thorough adaptation of instruction to individual differences in maturity, ability, needs and interests. All of this is coupled with the fundamental concept that education is a developmental process, not a teaching job, and that the most fundamental learning is done at the time that one is participating in real and vital experiences. In order to provide this point of view, so that teachers could assume their responsibilities, opportunities for graduate and postgraduate instruction in the field of growth and development and individual differences in children were provided by means of six and eight weeks' courses for superintendents of schools and teachers at various universities and teacher training centers throughout the country and by extension courses brought to the local teacher groups. In all, during the past five years, 1,342 of the 1,985

teachers of the area have availed themselves of one or more of these courses, given in ten different institutions. This has now developed into a continuous educational program for teachers, who are now capable of assisting the dentists in a modern and progressive manner.

After the teachers had an opportunity to provide the child with a knowledge of certain facts concerning dental health and its relation to general health, and to prepare him for the dental examination, each dentist in the area assumed the responsibility for examining his own and prospective patients. For this examination, the county health department contributed $3 per hour for the time the dentist spent on each examination. By and large, the profession has not received remuneration for this type of service, and the dental society informed the people that they were cooperating with the county health department in this program and were being remunerated for their time, thus educating the people to the fact that the county health department thought enough of this type of service to pay for it. The county health departments justified this expenditure on the basis of the educational value of the examination to the people of the community, and not as a payment to the dentists for technical service.

Soon after this program was started, it seemed desirable to improve the type of examination and indirectly increase its effectiveness, not only as an educational technic, but also as a means of improving the type of dental service in the community. Since the basis of this preventive program was to be the early recognition of defects, it was imperative that the dentist find every defect. The bite-wing x-ray seemed to be the most usable technic for the group as a whole. Therefore, the health department, at the request of the dental society, agreed to contribute toward bite-wing x-ray films at the time of examination. It was realized that it would necessitate more time for each examination and thus a greater expenditure, but that the educational value of the examination would be multiplied many times. This naturally placed those men without x-ray equipment at a disadvantage; for the news soon spread that certain dentists always used the x-rays at the time of examination. Today, the office without x-ray equipment in this area is a rarity. I bring this point up because it is, I believe, essential that we as dentists avail ourselves of every opportunity to provide a better and more complete service in our respective communities and, if we have available technics that we know are valuable and we fail to utilize them because of economic conditions, we are harming no one but ourselves. The x-ray is now another necessary tool that we have at our disposal and it should be used and not exploited.

The examination program for the first two years consisted of an examination for the entire school group in an effort to educate as large a group as possible in a short time; but, since that time, it has been confined to the group receiving care within the age limits of the remedial program, which was the next program developed by the dental societies.

At the completion of the examination program, the problem was: "Now that we have examined all these children and created a demand for dental care, what can we do about it?" Too often in our dental programs, we have conducted annual examination programs for preschool and school children without providing a plan for the correction of defects. We educate the child and parent to the need of dental service without having any plan for its provision. The dentists realized that they did not have the time or the man power to provide complete care for the entire group examined because of the tremendous amount of restorative work that so many of them required. They decided to confine the program to a small group and do a thorough job, real-

izing that the older groups would be neglected for the time being, but that if the program were to be continued for a period of years, the older group would be replaced by the new group, and eventually the program would reach every child. Therefore, the first year, the remedial program was confined to children 6, 7 and 8 years of age. The families in this group divided themselves into three economic classes as far as the dentist was concerned: (1) those who had sufficient funds to pay for the correction of the defects present; (2) those who could afford to pay only part, and (3) those who had no means whatsoever. Rather than add the cost of expensive case work machinery to the cost of dental service, it was decided that as the economic status of the majority of the families involved was known to the dentist, each dentist would himself determine which of the cases needed financial assistance and which could afford to pay for their care. The health department, realizing that the dentists would be unable to assume the total responsibility for those unable to pay for dental service, again offered to contribute toward the cost of remedial work on all part pay and indigent cases coming within the age group mentioned. This meant that if the child fell into either the part pay or indigent class, the family, through the dentist, could ask for financial assistance from the health department, thus allowing the dentist to provide complete remedial care for all children within the age group. The financial assistance from the health department was placed on the same hourly basis as for the examination program. This did not prove to be a hardship for any one dentist, provided the funds for dental care to the entire group and left the problem of determining which child or family was deserving financial assistance directly in the dentist's hands. This technic is again routine as far as private practice is concerned; for, every day, dentists must determine the ability of their patients to pay. However, this is one of the first responsibilities that dentists try to unload on an outside agency endeavoring to assist; which only increases the cost of dental service to the public.

To make sure that periodic service would be provided, the health department and the dentists agreed that when a child had once entered on the remedial program, he was to be examined at regular intervals; that is, every three, six, nine or twelve months, as the dentist saw fit, at which time all new defects were to be corrected. The recheck program was to continue until the child was 11 years of age, and if at any time during this period the dentist felt that this family was deserving of financial assistance, the county health department would continue to give it. Assistance was to be discontinued for a child when he became 11 years of age, because it was believed that if, during this period, we were unable to educate the child and the parent to the value of dental service, we probably would never be able to do so, or if we were unable to reduce the cost of dental care so that it was within their means, they would probably fall within that group of people who always have to have health service provided by some outside agency. This program was not to be a relief program, but an educational one; and neither the health department nor the dental groups are making plans as to the method of providing health service for this group of chronic indigents.

At the start, this remedial program was confined to the school child, because the dental group was unfamiliar with the technic and procedures necessary to provide care for the preschool child. If the program was to be preventive in the sense that we were considering preventive dentistry, it must start with the preschool child, so as never to have a curative problem at any age. To make this preschool program possible, it was necessary

to rely upon the interest and activity of other community resources, because here we lacked the facilities of teachers to educate and prepare the child for the dental examination. This problem was answered by bringing about close cooperation between the dental society and the medical society and between lay leaders and adult groups in the area. The necessity for dental care in the preschool group was discussed with the physicians and it was agreed that they would advise the parents of their child patients to go to the family dentist for a dental examination sometime between the second and the third year. This resulted in a very definite tieup between the medical group and the dental group and definitely set the time when the physician should first recommend that the normal youngster start to receive dental care. Lay groups, or service committees, as they are called in this area, were developed during the early days of this program to assist in all of its phases. They have assumed the major responsibility for contacting all mothers of preschool children in these counties, advising dental examinations and other health measures.

Each preschool parent is requested to make an appointment with the family dentist. If, at the time of examination, remedial work is found necessary, the dentist follows exactly the same procedure for this group of children as he does for the school group; that is, if the family is unable to pay for dental service, financial assistance is requested from the health department. Today, the program starts with the 2-year old child and continues through the 10-year old child. In other words, each child has an opportunity of being in this program for eight years; which gives the dentist a much longer time to educate the child and parent to the value of preventive service.

Soon after the program was started, it was apparent that some measures would have to be taken to bring about a better understanding concerning dentistry for children. Many of the group had practiced little children's dentistry; others were reluctant to enter on a program that would materially increase the number of children in their practices; while others were interested, but felt unprepared to cope with the problems that children present. These were the basic reasons, referred to earlier, for starting the program with the school group which already presented a curative problem. The school group presented a problem of corrective work on both deciduous and permanent teeth, and our hope was that at least the permanent teeth would receive proper attention until such time as measures could be taken to bring about a better understanding of dentistry for children.

In analyzing the needs of the dentists, the majority of whom had been out of school for at least ten years, we concluded that they all should have an opportunity to (1) review the newer technics in all fields of dentistry that had been developed in the last ten years; (2) study operative technics relating to deciduous and permanent teeth in children, the majority of this group having learned, much to their embarrassment, that technics applicable to permanent teeth in adults were not applicable to their younger patients; (3) obtain a better understanding of growth and development and the individual differences of children, and (4) develop a better understanding of modern educational technics, the great difference between curative and preventive dentistry being that the latter demands an educational technic while the former depends primarily on sales technic.

In the summer of 1933, the first year of the program, through the assistance of the late Arthur D. Black and Frank Blaine Rhobotham, such a course was developed at Northwestern University. It was necessary to utilize not only the facilities of the dental school, but also those of the medical school and the school of

education in order to provide the content here mentioned. This two-week course was made available to every dentist practicing in the area, the county health department giving each dentist sufficient money to cover tuition, transportation and living expenses. Needless to say, during the next twelve months, every dentist in the area accepted this opportunity. The groups were confined to about twelve men and, in addition to the subject material and technics learned, a unity of feeling and purpose developed, and the fellow across the street or in the neighboring town proved to be quite a decent fellow after all.

It was evident, after this first series of courses, that some plan would have to be developed for the continuous education of the dentist. Two additional centers were developed with the idea of providing this group with an opportunity of obtaining a broader concept of children's dentistry by studying and observing methods and technics used in other parts of the country. Through the cooperation of Percy R. Howe, of the Forsyth Dental Infirmary, in Boston, and John Oppie McCall, of the Guggenheim Dental Clinic, in New York, two-week courses were developed at these centers. The health departments again contributed sufficient funds to cover the expenses of each dentist attending. To date, 80 per cent of the men have availed themselves of all three courses.

These courses have been supplemented by lectures and demonstrations before the local groups in their own communities, and have been of two types: (1) evening lectures by outstanding men in the various fields of dentistry and (2) extension courses. The extension courses are confined to one phase of dentistry. For instance, last year, one of the county groups consisting of twelve men desired more intensive work in the field of oral surgery. An outstanding man in this field met with this group on ten different occasions. The first meeting consisted of an evening lecture. On the following occasions, a full day was spent in the county, one-half day with each of two men in their offices, where they had an opportunity to present their own problems and operate under the guidance of a highly trained individual. The evening was then spent with the entire group in discussions and in presentation of additional subject matter. This has proved to be a valuable educational technic, and there are few fields of dentistry in which it is not applicable.

It is evident from our experiences in the postgraduate field that one of the greatest problems confronting the profession today is the development of a plan for continuous education. There is a tremendous difference in the quality of service that is rendered by various members of the profession and the percentage who are not rendering a true health service is far larger than any one of us is willing to admit. We have been talking about education of the people as to the value and necessity of adequate dental care, and we, as a profession, are not in a position today to render that type of service. The education of the public is very easy, but the danger arises at the time when the public is educated as to what constitutes good dental service and then finds that it is not available in many dental offices. Will it then demand that the practice of dentistry be placed on a different basis?

The fault is not entirely with the individual dentist: the opportunities for study in the various fields are not available, the dental schools, in most instances, have not assumed any responsibility for the education of their graduates and the majority of societies have not had sufficient money to carry on extensive programs for their members. Most of the dental schools are state supported, founded for the purpose of providing service for its people, and this must imply a responsibility for seeing that this service is the best obtainable throughout the

entire professional career of every dentist.

We hoped that after each dentist had the opportunity of attending these three courses in children's dentistry, the opportunity could be afforded him to spend at least two weeks each year to eighteen months in studying in one of the various fields of dentistry in order to develop a better than average technic in this field. If this could be done over a period of years, each year in a different field and from time to time a generalized course, we would raise the standard of practice and service. Such courses were not available. The board of trustees of the Kellogg Foundation, realizing the need, made available to the University of Michigan a grant (of $110,000) to be spent over a five-year period to develop a school of graduate and postgraduate dentistry and to determine what the demand was for graduate and postgraduate study. It further stipulated that the tuition be kept to a minimum, believing that if a dentist had to leave his practice, which meant giving up his income, he could afford no further financial drain.

The demand during the first year was so great in all fields of study that this year an additional grant (of $250,000, to be matched by a federal grant) was made to erect a school of graduate and postgraduate instruction in dentistry and make available to the profession an opportunity for continuous study.

Since the inception of this program, the various county health departments have attempted to compile information that would allow us to evaluate the program at any time. As the county health department is providing financial assistance toward the cost of the examination program and the remedial program, it has requested that the dentists send the county health department certain information concerning every child at the time he requests payment for services rendered. The five charts presented afford some idea as to the effectiveness of various phases of this program.

As stated earlier in the paper, we would rather make 50 per cent of the examinations in the dentist's office than 100 per cent in the school. It will be noted that the school population in one county (Chart 1) for those within the group eligible for examination was 4,133, of which in 1935-1936 1,620, or 39.0 per cent, were examined, this being the first year the program was operating in this county. In 1936-1937, 2,381 children were examined, or 57.6 per cent, and in 1937-1938, that is the year ending August 31, 1938, 3,042, or 73.6 per cent, were examined. This being one of our newer counties, the x-ray program was not inaugurated until last year, and 450, or 14.8 per cent, of the total number examined had the bite-wing x-ray examination. While this is not an exceptionally large percentage, we believe that this year the group began to realize the importance of this step and that, as the program develops, this percentage will greatly increase. In the preschool group, which consists of 3,434 children from 2 through 5 years of age, this last year, 24.6 per cent were examined. Of this number, 19 per cent, or 131, were x-rayed. The preschool program is a much more difficult program to develop since the educational work with the child must be accomplished through individual contacts with the parent. In one of the older counties where figures were not available in time to prepare a chart of accomplishments, 1,960 children in the school group were examined, 52 per cent with x-rays, and 491 preschool children were examined, 34 per cent with x-rays. Granted that the examination program as such shows fair results, a true determination of its value as an educational procedure lies in the influence it has in motivating the child and parent to have something done in a positive way about defects. A true evaluation of our examination program as an educational measure, therefore, lies in an analysis of the remedial program.

The remedial program is much more difficult to evaluate, but since the inception of the program, the dentists have been most cooperative in their effort to provide the necessary information on this program. Every dentist in the area reports to the health department each year the number of children between 2 and 18 years of age for whom he has provided complete dental care, in addition to furnishing information as to the number of fillings, extractions, etc., in all cases requiring financial assistance from the health department. From this information, we are able to determine the amount of dental service, the kind of dental service and the time necessary to provide dental service for the various age groups of children involved in the program.

In 1932, a general survey was made of the dental conditions of the children in this area. Chart 2, solid line, shows the percentage of children needing dental care varies from 50 per cent for the 2-year-old group up to 83.4 per cent for the 8-year-old child. The first year of the program, 1935-1936, 16 per cent of the children in Branch County received complete dental care. In 1936-1937, 44 per cent were given complete care, and in 1937-1938, 51 per cent of all the children between 2 and 18 years of age were given complete dental care. It will be noted that this care reached 80 per cent for the children 7 or 8 years of age. This shows that the educational program has gone a long way toward providing more complete care for the children in this area.

Chart 3, page 496, was developed to show the ratio of the amount paid by the family to the amount paid by the health department. Since we know the average time required to provide complete care for the children of the various age groups and also know the number of children who are given complete care by the dentists of any one county in each of the age groups, we can quite accurately determine the cost of dental care for the children reported as having complete dental care. As I stated, the health department's financial assistance is given on the basis of $3 an hour. These figures are prepared on the basis of $4 an hour, which probably more nearly approximates the average fee for the dentists in this particular area. It will be noted that in this particular county, in 1934-1935, 76.7 per cent of all children given complete dental care paid for it, and 23.3 per cent required a contribution from the health department. On a dollar-and-cents basis, the families contributed $4,745 toward the care of these children while the health department contributed $1,435. In the same county, during 1935-1936, the family paid for 92.4 per cent of all child dental care, or $19,907, while the health department paid for only 7.6 per cent, or $1,617. The next year, the picture remained about the same; while last year, the families contributed toward 84.6 per cent of child care and the health department's contribution amounted to 15.4 per cent; or, on a dollar-and-cents basis, the families contributed $22,990, while the health department contributed $4,186. For the area as a whole, during the first year of our activities, the health departments contributed toward 48 per cent of all complete dental care. This figure has been decreasing steadily, and today we are contributing to only approximately 20 per cent of the entire group now receiving care. This shows definitely that many more people are able to afford the small preventive cost when they are educated to the value of this service as mentioned a moment ago.

We are also able to determine, from the reports submitted in the remedial program, the amount of time the dentist spends on each case. Chart 4 shows that the average time spent by the dentist in this area on a new case (the child going to the dentist for the first time) is 106 minutes, and this varies from about

eighty or ninety minutes for the younger age groups to two hours for the children 7, 8 or 9 years of age. The average time spent on recheck cases (as shown by the solid line) varies from thirty-five to fifty minutes for children between 2 and 3 years of age to seventy-five minutes for children 6, 7 or 8 years of age, or an average of sixty-six minutes for the entire group. In other words, it requires about half as much time per individual patient to practice preventive dentistry as to practice curative, and far more people can afford this smaller periodic cost than can afford the large bills for curative care at infrequent intervals.

It is interesting to note the effect that this program has had upon the individual practice of some of the dentists in this area, as shown in Chart 5. Dentist A is a young man practicing in a community of approximately 1,300 people. The first year, he reported that he had given 275 children complete dental care. The next year, 1,004 children were given complete dental care; and last year, 1,200 children. Needless to say, this man's practice is now composed primarily of children, but because he is the only man practicing in this area, it is necessary that he spend the majority of his evenings working on adult patients.

Dentist B is a man who has been out of school approximately fifteen years and practices in a community of approximately 7,000 people. In three years, the number of children he has taken care of has increased from 193 to 816.

Dentist C is a dentist of middle age practicing in a community of about 3,000 people. For the first two years, the program had little effect on his practice. This community was a little difficult to approach and one in which some of the technics that had already been developed regarding school health service were giving satisfaction. However, in the past year and a half, an interest in this particular program has developed, and Dentist C's practice definitely shows the effect.

Dentist D is a young man who located in a community of approximately 200 people. A new consolidated school had been built in this community, and we believed that a dentist could make a very fine living in this area and encouraged this young man to start a practice in this community. While the number of children given complete care is not so great as shown on the chart by some of the other men, Dentist D is well above the average for the dentists in the area.

Dentist E, who is well over 60 years of age, had little interest in children's dentistry, and, as may be noted, provided complete care for only thirty-two children the first year. The next year, after one postgraduate course, his interest increased, and he is now one of the real enthusiasts for better dental care for children. Last year, he provided complete dental care for 463 children.

CONCLUSION

A community's resources cannot be measured in terms of a few years' results, but the few facts which have been collected encourage us more than ever to believe that our own local citizens can do much in the way of assuming their own health responsibility if given a chance to participate.

CURRENT LITERATURE

Effect of Vitamin A Deficiency on the Rate of Apposition of Dentin

By Isaac Schour, Margaret C. Smith and M. M. Hoffman

The rate of dentinal apposition in sixty albino rats on a complete vitamin A deficient diet was studied. The thickness of the deposit was marked by two injections of alizarine red S. Apposition of dentin was hastened on the labial and retarded on the lingual pulpal wall. These effects appear before any cytologic changes. The authors suggest that the rate of dentinal apposition may be used as an animal-assay method for vitamin A.—*Proc. Soc. Exper. Biol. & Med.*, 39:447, December 1938.

Martin Deakins.

Incidence of Extragenital Chancres

By J. G. Downing

A review was made of 691 cases of primary syphilis seen at the Boston City Hospital 1908-1930. Extragenital chancres were observed in thirty-eight, approximately 6 per cent, of these cases, 79 per cent of these chancres occurring on the lips or tonsils, an indication of the frequency with which the mouth may be primarily infected.—*Arch. Derm. & Syph.*, 39:151, January 1939.

Frank Allen.

Bacterial Flora in Experimental Dental Caries of the Rat

By R. Wendell Harrison

Bacterial cultures were made on various media from the teeth of fifty young rats being fed caries-producing diets. Twenty had a "high incidence" of caries and ten a "low incidence," and twenty had little or no caries. Streptococci comprised from one-half to three-quarters of the resulting colonies. The remainder were largely lactobacilli, staphylococci and micrococci. The low incidence of lactobacilli in cultures from carious teeth suggests that they are not involved in advanced caries, whereas the high incidence of acidogenic streptococci is evidence of their relationship to the lesion.—*Proc. Soc. Exper. Biol. & Med.*, 39:459, December 1939.

Martin Deakins.

Nature of the Human Factor in Infantile Paralysis. I Peculiarities of Growth and Development

By G. Draper & C. W. Dupertuis

Methods of observation used to study the morphology of those affected with infantile paralysis are described. Among the susceptible, growth is hastened and development retarded. Earlier clinicians noted that the disease did not affect the teeth, but no explanation is given.—*J. Clin. Invest.*, 18:87, January 1939.

B. J. Frey.

Relation of Refractive Index to Density in Dental Hard Tissues

By Richard S. Manly

The mean refractive indices of powdered enamel and dentin samples, with differing and known density limits, were determined by the Becke line procedure. The refractive indices of dried enamel were found to lie between 1.612 and 1.630 and were proportional to the density. The refractive indices of dried dentin lie between 1.555 and 1.580 and are roughly proportional to the density when the fractions are dried under the same conditions for both determinations. Vacuum drying brought about a marked lowering of the refractive index. Secondary cementum exhibited a refractive index of 1.560-1.570, which was little affected by vacuum drying. The author suggests that a refractive index will be valuable as a measure of the density, and thus as a measure of the extent of calcification.—*J. Am. Chem. Soc.*, 60:2884, 1938.

Virgil D. Cheyne.

A Few Observations in Forty-Nine Cases of Epidemic Parotitis

By E. R. Schwartz and H. W. Husband

Forty-nine cases of epidemic parotitis were observed at the Kansas State College

during the school year 1937-1938. Of these, thirty-four were in men and fifteen in women.

One hundred white blood counts were made. Most of these showed a mild to severe leukocytosis and 75 per cent showed a lymphocytosis. Temperatures were highest during the first four days of the quarantine.

Of the men, 29.4 per cent developed orchitis, accompanied in all cases by an elevated white count and a lymphocytosis. Orchitis occurred at any time during the course of the disease.—*Kansas M. Soc. J.*, 40:10, January 1939.

VIRGIL D. CHEYNE.

Fracture of the Jaw

By FULTON RISDON

THE author discusses briefly the reduction of fractures of the bones of the face and jaws, particularly emphasizing his own method of treating fractured jaws. He employs a strand of coarse Angle wire 187, which he places around a molar tooth and twists upon itself as far forward as the central incisors, where it is joined by a wire from the opposite side. These wires are joined, forming an arch wire to which is wired each tooth in the arch. The same method follows on the opposing arch, and interdental wiring is accomplished by wiring between the arch wires at the required intervals. The interdental wires may be divided without disturbing either arch.—*Canad. M. A. J.*, 39:572-573, December 1938.

FRANK ALLEN.

Comparative Study of the Development in Vivo and in Vitro of Rat and Rabbit Molars

By S. GLASSTONE

To determine how far the formation of molar cusps was due to extrinsic factors in the jaw and how far to intrinsic factors in the tooth germ, the development of tooth germs, established in artificial culture before cusp differentiation occurred, was compared with that in normal animals. For this purpose, the first lower permanent molar of embryonic rats and the two lower temporary molars of rabbits were chosen.

The first part of the paper describes in detail the normal development of the teeth in the animals studied. The *in vitro* studies showed that the molar tooth germs manifested remarkable powers of anatomic and histologic development in culture. Cusps almost normal in shape, number and arrangement were formed. Odontoblasts and dentin differentiated in the cultures and the internal enamel epithelium differentiated into ameloblasts which formed enamel. It is concluded that the factors responsible for the development of cusps are intrinsic in the tooth germs and entirely independent of external mechanical conditions in the jaw.—*Proc. Roy. Soc.* (Series B), 126:315, 1938.

B. G. BIBBY.

Pyorrhea and Paradentosis

By RENÉ JACCARD

THE author discusses the confusion occasioned by the great volume of conflicting literature dealing with the etiology, pathology and treatment of pyorrhea, outlining briefly the findings of the international association which investigates peridental pathosis. Peridental lesions are classified as hypertrophic, inflammatory and atrophic, with subgroups under each general type. The rôle of local and general factors in the etiology are discussed.—*L'Inform. D.*, 21:8-10, 1939.

FRANK ALLEN.

Changes in the Serum Calcium, Inorganic Phosphate and Phosphatase Activity in the Pregnant Woman

By M. BODANSKY, K. CAMPBELL and E. BALL

THE authors studied the serum calcium, inorganic phosphate and phosphate activity in 300 pregnant subjects. The average serum calcium was 9.8 mg. during the second trimester and declined in the seventh, eighth and ninth months. The average at term was 9.5 mg. Attention was drawn to the finding of an increased hypocalcemia (value below 9 mg.) as pregnancy advances. The inorganic phosphate average for the second to the seventh lunar months was 3.23 mg. This fell slightly in the eighth and ninth months, but increased in the tenth month to a value of 3.29 mg. A marked shift to a higher phosphatase activity became apparent in the seventh month and became more conspicuous as pregnancy advanced.—*Am. J. Clin. Path.*, 9:36, January 1939.

J. VOLKER.

Dental Caries, Carbohydrates and B. Acidophilus

By J. King and J. Croll

Two groups of children, eight from Sheffield and thirty from the Isle of Lewis, were kept four months on identical basal diets to which was added daily 2 ounces of carbohydrate in the form of toffee. No consistent increase in *B. acidophilus* could be shown. There was no definite relationship between the incidence of caries and *B. acidophilus* content of the saliva.—*Brit. D. J.*, **66**:19, January 1, 1939.

Martin Deakins.

Dental Caries and Nutrition

By E. Schiotz

A study was made of the teeth of 338 children living in twenty-three children's homes where accurate data concerning the dietaries were available. No correlation could be established between the consumption of sugar and the health of the teeth, but the regular supply of cod liver oil in winter seemed to be beneficial.—*Bul. Hyg.*, **13**:937, 1938; *Nord. Hyg. Tidsskr.*, **19**:242-308, 1938.

Martin Deakins.

Mechanism of the Action of Saliva in Blood Coagulation

By A. Glazko and D. M. Greenberg

The authors confirm the report that saliva accelerates the coagulation of blood. They believe that the saliva owes its blood-clotting properties to the presence of a substance acting as a thromboplastin. It appears to be a protein, possibly a lipoprotein. It may be partially purified by precipitation with ammonium sulfate and dialysis.—*Am. J. Physiol.*, **125**:108, January 1939.

J. F. Volker.

Dental Defects in Congenital Syphilis

By B. G. Anderson

The author summarizes the dental abnormalities that are considered to be of a congenital syphilitic origin. In each of the patients examined, the eight incisors, the four cuspids and the four permanent molars were found to be involved, whenever present. The "three most characteristic abnormalities" are listed in the following order: (1) the undersized, malformed appearance of the teeth; (2) the contracted appearance of the mamelon, marginal ridges and cusps of the molars, cuspids and molars, and (3) a peculiar open-bite occlusion.—*Am. J. Dis. Child.*, **57**:52, January 1939.

J. F. Volker.

Endemic Fluorosis and Its Relation to Dental Caries

By H. T. Dean

An excellent review is given of the literature on the relation of endemic fluorosis to dental caries. The author's own report deals with a comparison of dental caries in 236 9-year-old children in communities with high concentrations of fluorides in the water with caries in children in areas having a water supply low in fluorides. Those from areas with a high fluoride content had a limited immunity to dental caries in the deciduous and permanent teeth. Analysis of cases in three states (South Dakota, Colorado and Wisconsin) demonstrated a similar limited immunity from areas high in fluorides in the water.—*Pub. Health Rep.*, **53**:1685, 1938.

Joseph Volker.

Thyroid Deficiency in Sheep

By T. Wingate Todd, R. Wharton and R. Todd

Deficient growth in thyroidectomized sheep is apparently the direct effect of hypothyroidism produced through the disturbance in endocrine function. The general effects are diminished growth and modeling of the epiphyses. The skeleton is affected, but viscera and brain escape alteration in size and structure. In the skull, the retarded growth is most evident in the premaxilla and maxilla. The mandibular growth is relatively unaffected. Tooth eruption and development is somewhat retarded, but no defects are found in enamel or crown pattern, nor is there evidence of caries, which the authors note is contrary to the contention of some investigators.—*Am. J. Anat.*, **63**:37, July 1938.

William E. Hahn.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Grinding Porcelain Facings—To eliminate guesswork in regard to the part of the porcelain facing or pontic to be ground in bridgework, an ordinary soft lead pencil will be found useful. The ridge of the model is thoroughly blackened with the carbon pencil. The facing or pontic backed up by soft, black carding wax is placed on the model in the approximate position in which it will finally be. It is then rocked back and forth slightly over the penciled area on the model. The carbon markings on the base indicate the high spots on the porcelain. These are then reduced by grinding until the entire base fits against the ridge lap, as indicated by the pencil markings there.—*David Waldman, Brooklyn, N. Y.*

Prevention of Tooth Injury in Metrazol Treatment—In some patients receiving metrazol treatments, the teeth and bridges are frequently so loosened during the period of convulsions that the teeth are lost There is no known method of restoring these teeth that is not expensive. At first, there was much of this trouble at the Elgin State Hospital. Now the staff goes to the shoe shop and, as a makeshift, gets a large new rubber heel, which is usually about one-half inch thick, splits it and cuts strips from it little more than an inch wide and one quarter inch thick. This is wrapped with a piece of gauze and slipped back far enough to engage the bicuspids and molar teeth. It is not necessary to engage both sides, only the side on which there are the greater number of back teeth. It seldom loosens a back tooth, but is certain to loosen or damage anterior teeth if undue stress is exerted on them. It is not uncommon for a healthy human jaw to exert a force of 200 pounds. Of course, all movable appliances are removed from the mouth before metrazol is given. Since this method was adopted, very few teeth have been damaged.—From *Psychiatric Exchange.*—*W. N. Sullivan, D.D.S., Elgin State Hospital, Elgin, Ill.*

Ethyl Chloride for Pulp Testing—Electrical pulp tester findings are frequently inconclusive or confusing, but refrigeration will invariably settle the issue. Since the use of ice is inconvenient and difficult to control, a tube of ethyl chloride is kept handy for making quick refrigeration tests. A stream of the highly volatile fluid caught in the end of a cotton roll will produce intense cold and frost in the roll, leaving the dry end available for manipulation. This can be pressed tightly against the crown of the tooth in question without bringing it in contact with adjacent tissues. If the tooth is vital, the response will be immediate and unmistakable. The tooth may be isolated with a rubber dam and a few drops of the chloride be brought directly in contact with the crown. Care must be exercised not to overchill the tooth. Only a very small quantity is necessary.—*L. M. Lucas, 900 Seventeenth St., N.W., Washington, D. C.*

THE AMERICAN BOARD OF ORTHODONTIA

CERTIFICATES of qualification were granted to the following orthodontists by the American Board of Orthodontia in 1938:

Culmer Coleman Benton, San Diego, Calif.

Walter Coolidge Chapin, New York City.

William T. Chapman, El Paso, Texas.

George Campbell Chuck, Long Beach, Calif.

Edwin Grant Flint, Pittsburgh, Pa.

William Revis Flint, Pittsburgh, Pa.

C. S. Foster, Cedar Rapids, Iowa.

Emery James Fraser, Seattle, Wash.

Guy Melton Gillespie, Abilene, Texas.

I. Eugene Gould, Pasadena, Calif.

Alfred R. Higson, Beverly Hills, Calif.

Sidney Blaine Hoskin, Portland, Ore.

Walter Lloyd Hyde, Minneapolis, Minn.

Edmund M. Johnston, Riverside, Calif.

Jesse A. Linn, Los Angeles, Calif.

Fred E. McIntosh, Los Angeles, Calif.

Philip T. Meaney, Portland, Ore.

Hays N. Nance, Los Angeles, Calif.

Francis William Nash, Scranton, Pa.

*Ray W. Noland, Des Moines, Iowa.

Harold Edward Sippel, Buffalo, N. Y.

Harvey Stallard, San Diego, Calif.

Charles H. Tweed, Jr., Tucson, Ariz.

James Thompson Walls, Portland, Ore.

E. Farris Woodring, Tulsa, Okla.

HARRY E. KELSEY, *President,*
CHARLES R. BAKER, *Secretary.*

*Posthumous.

DEATHS

Barker, Albert M., San Jose, Calif.; College of Physicians and Surgeons of San Francisco, A School of Dentistry, 1899; died recently; aged 79.

Long, Amos Marion, the oldest practicing dentist in Michigan, and for fifty-eight years a member of the Michigan State Dental Society, died at his home in Monroe January 1, 1939, after a two weeks' illness with a heart attack. He was in his ninetieth year and had been practicing dentistry for more than seventy years. Although long past the age when most men are active, Dr. Long was still a familiar figure at dental meetings. Dr. Long was born in Jay County, Indiana, May 2, 1849. When 18 years of age, he went to Manchester, Pa. Dr. Long matriculated at the University of Michigan and received the degree of D.D.S. in 1880.

Merritt, John Brown, Carmel, N. Y.: New York University College of Dentistry, 1889; died December 9; aged 71.

Smith, D. Sherman, Lancaster, Pa.; Temple University School of Dentistry, 1890; died December 25.

Thompson, Herndon W., Hamlet, N. C.; Atlanta-Southern Dental College, 1921; died December 11; aged 43.

Thompson, Walter G., Lieutenant-colonel, Hamilton, Ontario, Canada; Royal College of Dental Surgeons, 1899; died January 8; aged 67.

Tully, Joseph F., Hartford, Conn.; Tufts College Dental School, 1924; died January 30; aged 38.

Way, R. L., Converse, Ind.; Indiana University School of Dentistry, 1923; died January 7; aged 40.

Wise, William Calkins, Fond du Lac, Wis.; Northwestern University Dental School, 1890; died December 8; aged 72.

Wyeth, C. L., Newark, Ohio; Chicago College of Dental Surgery, 1896; died December 16; aged 67.

Members of the American Dental Association:

The dental profession of the states of Colorado, Kansas, Missouri, New Mexico, Arkansas, Texas, Louisiana and Oklahoma cordially invite you to attend the Southwest Dental Congress the last week in April of this year. A complete program for instruction and entertainment is at your disposal.

I should consider it a pleasure to send you a program and arrange your hotel reservations.

F. J. REICHMANN, *President,*
607 Medical Arts Bldg.,
Oklahoma City.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

American Dental Association, Milwaukee, Wis., July 17-21.

American Association of Orthodontists, Kansas City, Mo., April 17-20.

American Academy of Restorative Dentistry, Milwaukee, Wis., July 15-16.

American Society of Oral Surgeons and Exodontists, Milwaukee, Wis., July 14-15.

American Society for the Advancement of General Anesthesia in Dentistry, New York City, fourth Monday in March and October.

National Board of Dental Examiners, May 1-2.

American Board of Orthodontia, Kansas City, Mo., April 15.

North Atlantic Orthodontic Society, New York City, April 26.

Five State Post Graduate Clinic, Washington, D. C., March 5-9.

Southwest Dental Congress, Oklahoma City, Okla., April 24-28.

Southwestern Society of Orthodontists, Kansas City, Mo., April.

Cleveland (Ohio) Dental Society, April 3-4.

District of Columbia Dental Society, second and fourth Tuesdays in each month from October to June, at the United States Public Health Service Auditorium, Washington.

Ontario Dental Association, Toronto, June 5-7.

American Dental Society of Europe, Lausanne, Switzerland, August 7-9.

Congress of Australian Dental Association, Melbourne, August 21-26.

American Dental Assistants Association, Milwaukee, Wis., July 19-21.

Southwest Dental Assistants Congress, Oklahoma City, Okla., April 24-28.

STATE SOCIETIES

March

District of Columbia, at Washington (5-9)

Louisiana, at New Orleans (23-25)

April

Alabama, at Birmingham (11-13)

Arkansas, at Oklahoma City, Okla. (24-28)

Kansas, at Oklahoma City, Okla. (24-28)

Kentucky, at Louisville (3-5)

Massachusetts, at Boston (24-27)

Michigan, at Detroit (17-19)

Missouri, at Oklahoma City, Okla. (24-28)

New Jersey, at Atlantic City (19-21)

New Mexico, at Oklahoma City, Okla. (24-28)

Oklahoma, at Oklahoma City (24-28)

Texas, at Fort Worth (10-13)

Virginia, at Roanoke (10-12)

May

Connecticut, at Bridgeport (3-5)

Georgia, at Augusta (15-17)

Illinois, at Peoria (8-11)

Indiana, at Indianapolis (15-17)

Iowa, at Des Moines (2-4)

Montana, at Livingston (4-6)

Nebraska, at Omaha (15-17)

New York, at New York City (9-12)

North Carolina, at Raleigh (1-3)

North Dakota, at Grand Forks

Pennsylvania, at York (2-4)

South Carolina, at Charleston (8-9)

South Dakota, at Aberdeen (22-23)

Tennessee, at Nashville (8-11)

Vermont, at Burlington (17-18)

West Virginia, at Huntington (15-17)

June

Colorado, at Colorado Springs (22-24)

Idaho, at Sun Valley (19-21)

Maine, at Bangor (25-27)

Mississippi, at Gulfport (12-14)

Nevada, at Reno (3)

New Hampshire, at North Conway (4-6)

Utah, at Ogden

Washington, at Wenatchee (11-14)

September

California State, at San Francisco

October

Southern California, at Los Angeles (15-20)
Hawaii, at Wailuku

November

Ohio, at Columbus
Puerto Rico, at Caguas City

STATE BOARDS OF DENTAL EXAMINERS

Arkansas, at Little Rock, June 19-22. Clarence W. Koch, 817 Donaghey Bldg., Little Rock, Secretary.

California, at San Francisco, May 22; Los Angeles, June 19. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Florida, at Jacksonville, June 26-30. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Indiana, at Indianapolis, June 6. J. M. Hale, Mt. Vernon, Secretary.

Iowa, at Iowa City, May 29-June 2. Hardy F. Pool, Mason City, Secretary.

Maine, at Augusta, June 28-30. Carl W. Maxfield, 31 Central St., Bangor, Secretary.

Montana, at Helena, July 10-13. Leonard A. Jenkin, 401 Ford Bldg., Great Falls, Secretary.

Nebraska, at Lincoln and Omaha, June 12-17. Mrs. Clark Perkins, Lincoln, Director.

New Jersey, June 26-July 1. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

North Carolina, at Raleigh, June 26. Wilbert Jackson, Rich Bldg., Clinton, Secretary.

North Dakota, at Fargo. L. I. Gilbert, 401 Black Bldg., Fargo, Secretary.

Ohio, at Columbus, June 26. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, June 20-24. W. A. McCready, 1115 Highland Bldg., Pittsburgh, Secretary.

South Carolina, at Columbia, June 8-10. T. C. Sparks, 1508 Washington St., Columbia, Secretary.

Texas, at Dallas, June 12-16. B. Carl Holder, 1009 Nixon Bldg., Corpus Christi, Secretary.

Vermont, at Montpelier, June 26-28. H. B. Small, 82 Church St., Burlington, Secretary.

Wisconsin, at Milwaukee, June 12-16. S. F. Donovan, Tomah, Secretary.

ALABAMA DENTAL ASSOCIATION

THE Alabama Dental Association will meet in Birmingham, April 11-13.

J. S. GILLESPY, JR., *Secretary,*
810 First Nat'l Bank Bldg.,
Birmingham.

MISSISSIPPI DENTAL ASSOCIATION

THE Mississippi Dental Association will hold its annual meeting at Gulfport, June 12-14, with headquarters at the Markham Hotel.

GEORGE P. EVANS, *Secretary,*
Bay St. Louis.

DENTAL SOCIETY OF THE STATE OF NEW YORK

THE seventy-first annual meeting of the Dental Society of the State of New York, component of the American Dental Association, will be held May 9-12, at the Hotel Pennsylvania, New York City.

GEORGE C. DOUGLASS,
80 Hanson Place,
Brooklyn.

ARKANSAS STATE BOARD OF DENTAL EXAMINERS

THE Arkansas State Board of Dental Examiners will conduct the next examination of applicants for dental licensure at Little Rock, June 19-22. All applications must be filed with the secretary not later than June 10.

CLARENCE W. KOCH, *Secretary,*
817 Donaghey Bldg.,
Little Rock.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

THE next examination to be conducted by the Board of Dental Examiners of California for a license to practice dentistry and a license to practice dental hygiene in California will be held at the Physicians and Surgeons College of Dentistry and the University of California in San Francisco, commencing May 22, and in Los Angeles in Room 804, City Hall, commencing June 19. All credentials must be in the office of the secretary at least twenty days prior to the date of an examination or the candidate will

not be eligible for that examination. Address all communications to

KENNETH I. NESBITT, *Secretary,*
515 Van Ness Ave.,
San Francisco.

FLORIDA STATE BOARD OF DENTAL EXAMINERS (CHANGE OF DATE)

THE annual examination for license to practice dentistry and to practice dental hygiene will be held in Jacksonville, June 26-30, at the Seminole Hotel. Preliminary applications must be filed sixty days prior to date of examination. Address all communications to

H. B. PATTISHALL, *Secretary,*
351 St. James Bldg.,
Jacksonville.

MAINE STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Maine State Board of Dental Examiners will be held June 28-30 at the State House, Augusta. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to the date of examination. Address all communications to

CARL W. MAXFIELD, *Secretary,*
31 Central St.,
Bangor.

MONTANA STATE BOARD OF DENTAL EXAMINERS

THE annual meeting of the Montana State Board of Dental Examiners for the examination of applicants to practice dentistry and dental hygiene will be held at Helena, July 10-13. Applications must be filed with the secretary of the board twenty days prior to the commencement of the examination. The dental statutes of Montana require graduation from an American dental school or college, preferably a class A institution. The law does not permit the acceptance of diplomas or other credentials from foreign universities.

LEONARD A. JENKIN, *Secretary,*
401 Ford Bldg.,
Great Falls.

STATE BOARD EXAMINATION OF NEBRASKA

THE next dental state board examination in the State of Nebraska will be held June 12-17. The first three days' examination (practical) will be given at the University College of Dentistry, Lincoln, and the Creighton College of Dentistry, Omaha. The last three days' examination (written) will be given at the State House, Lincoln. All applications must be on file in this bureau at least fifteen days prior to the first day of examination.

MRS. CLARK PERKINS, *Director,*
Bureau of Examining Boards,
Lincoln.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next annual meeting of the North Carolina State Board of Dental Examiners will be held at the State Capitol, Raleigh, beginning June 26. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information address,

WILBERT JACKSON, *Secretary,*
Rich Building,
Clinton.

OHIO STATE DENTAL BOARD

THE next examination of the Ohio State Dental Board will be held at the College of Dentistry, Ohio State University, Columbus, the week beginning June 26. All applications must be in the hands of the secretary at least ten days prior to the date of examination. For further information, apply to

MORTON H. JONES, *Secretary,*
1553½ North Fourth St.,
Columbus.

PENNSYLVANIA STATE DENTAL BOARD

THE next examination of the Pennsylvania State Dental Board will be held at both Pittsburgh and Philadelphia, June 20-24. All applications must be in the hands of the Department of Public Instruction at Harrisburg, at least ten days before the examinations. For further information, apply to

W. A. MCCREADY, *Secretary,*
1115 Highland Bldg.,
Pittsburgh.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE South Carolina State Board of Den-

tal Examiners will hold its next annual meeting at the State House, Columbia, June 8-10. All applications must be returned to the secretary at least thirty days before the examination begins.

T. C. SPARKS, *Secretary,*
1508 Washington St.,
Columbia.

TEXAS BOARD OF EXAMINERS

THE Texas Board of Dental Examiners will hold its next examination June 12-16, in Dallas, with the Adolphus Hotel headquarters. Applications must be filed at least ten days prior to the date of examination. For further information, address

B. CARL HOLDER, *Secretary,*
1009 Nixon Bldg.,
Corpus Christi.

VERMONT STATE BOARD OF DENTAL EXAMINERS

THE Vermont State Board of Dental Examiners will meet June 26-28 in the State House, Montpelier, to examine applicants for license to practice dentistry and dental hygiene. All applications, accompanied by the examination fee, must be in the hands of the secretary at least fifteen days before the date of the meeting. Address all communications to

H. B. SMALL, *Secretary,*
82 Church St.,
Burlington.

WISCONSIN BOARD OF DENTAL EXAMINERS

The next examination of the Wisconsin Board of Dental Examiners will be held June 12-16 at Marquette Dental School, Milwaukee. Applications and required fee must be in the secretary's office by June 6.

S. F. DONOVAN, *Secretary,*
Tomah.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Parts I and II, May 1-2, in schools where there are five or more candidates. For information and applications, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven.

NORTH ATLANTIC ORTHODONTIC SOCIETY

THE next meeting of the North Atlantic Orthodontic Society will be held in the Hotel Pennsylvania, New York City, April 26. All ethical members of the dental and medical professions are invited.

WALTER H. JACOBS, *Secretary,*
124 West Ninety-Third St.,
New York City.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS

THE Southwestern Society of Orthodontists will hold its annual business session at the time of the meeting of the American Association of Orthodontists in Kansas City, Mo., in April. The members will be notified by letter as to the exact time, date and place.

R. E. OLSON, *Secretary,*
1001 Union Nat'l Bank Bldg.,
Wichita, Kan.

SUMMER COURSES, CHICAGO DENTAL SOCIETY STUDY CLUB

THE Study Club of the Chicago Dental Society announces that short intensive courses will be presented at the study club headquarters in Chicago the week of July 24 (following the American Dental Association meeting in Milwaukee). All dental subjects will be covered. If you are interested in taking a course or courses relative to any dental subject, communicate with the Chicago Dental Society Study Club, 30 N. Michigan Ave., Chicago, and information will be forwarded to you.

MILDRED FLECK, *Supervisor.*

RESEARCH FELLOWSHIPS IN MEDICINE AND DENTISTRY, GRADUATE SCHOOL OF THE UNIVERSITY OF ILLINOIS

THE Graduate School of the University of Illinois announces the establishment of four research fellowships to be awarded for one year in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year (calendar year with one month's vacation). Fellows are eligible for reappointment in competition with new applicants. Candidates for these fellowships must have completed a training of not less than eight years beyond high school graduation. Mail appli-

cations to the secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk St., Chicago, Ill.

COLLEGE OF DENTAL AND ORAL SURGERY OF NEW YORK, CLASS OF 1921

THE Class of 1921, College of Dental and Oral Surgery of New York will hold a reunion and dinner at 7 p.m., March 15 at the Hotel Astor, Times Square, New York City. Make reservations through

MORRIS FIERSTEIN, *Secretary,*
218-29 Jamaica Ave.,
Queens Village, L. I., N. Y.

POSTGRADUATE COURSES AT THE UNIVERSITY OF PENNSYLVANIA

THE School of Dentistry of the University of Pennsylvania offers two special postgraduate courses, as follows:

1. Four day general refresher course, including local and conduction anesthesia, radiography, bacteriology, full denture prosthesis, partial denture prosthesis, ceramics, gold inlays and periodontia. The course will be conducted by the faculty of the school, aided by well-known specialists in the fields concerned. Time: June 5-8. Fee: $10, payable with application.

2. Ten day course in oral surgery, exodontia and local and general anesthesia. The course will consist in part of lectures on the subjects mentioned, supplemented by lectures and by demonstrations in anatomy, bacteriology, pathology and roentgenology pertinent to the clinical subjects. Most of the time will be spent in clinical instruction at the Evans Institute and at various hospitals. Time: May 29-June 8. Fee: $75, $25 to be sent with application and $50 payable at the time of registration at the school.

Applicants should state their school and class and dental society affiliation. They are not necessarily restricted to the University of Pennsylvania graduates, but alumni will be given preference in case the numerical limits are exceeded. Application for each course should be made to the dean, School of Dentistry, University of Pennsylvania, Evans Institute, 40th and Spruce Sts., Philadelphia, Pa.

NORTHWESTERN UNIVERSITY DENTAL SCHOOL, CLASS OF 1914

THE Class of 1914 of Northwestern University Dental School will celebrate the twenty-fifth anniversary of its graduation in June and will be the honored guests of the university during Home-Coming exercises. Exact dates will be announced later.

MILTON CRUSE, *Chairman,*
1977 W. 111th St.,
Chicago, Ill.

ONTARIO DENTAL ASSOCIATION

THE seventy-second annual convention of the Ontario Dental Association will be held at the Royal York Hotel, Toronto, July 5-7. Dentists from the United States and from parts of Canada outside Ontario will be welcome.

FRED J. CONBOY, *Secretary,*
86 Bloor St. West,
Toronto.

AMERICAN DENTAL SOCIETY OF EUROPE

THE next annual meeting of the American Dental Society of Europe will be held in Lausanne, Switzerland, August 7-9, 1939.

K. C. CAMPBELL, *Secretary,*
88 Portland Place,
London, W. 1.